Southern California Priority Corridor
Showcase Program Evaluation

Mission Valley Event Management (MVEM) Evaluation Report

FINAL

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Prepared for
California Department of Transportation
Division of Research & Innovation
1227 O Street
Post Office Box 942873
Sacramento, California 94273-0001

Prepared By
BOOZ ALLEN HAMILTON INC
1615 Murray Canyon Road, Suite 220
San Diego, California 92108

In Association with
CHEVAL RESEARCH INC
Post Office Box 3102
San Diego, California 92163

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Disclaimer

The contents of this report reflect the views of the author who is responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the State of California, Caltrans or the U.S. Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

Abbreviations & Acronyms

AIWS	Advance Transportation Management System Integrated Work Station
ATIS	Advanced Traveler Information System
ATM	Asynchronous Transfer Method
ATMS	Advanced Transportation Management System
ATMSi	Advanced Transportation Management System - Intermodal
Caltrans	California Department of Transportation
CCTV	Closed-circuit Television surveillance camera
CHP	California Highway Patrol
CM	Configuration Management
CMP	Configuration Management Plan
CMS	Changeable Message Sign
CORBA	Common Object Request Broker Architecture
COTS	Commercial Off-the-Shelf
CTC	California Transportation Commission
CVO	Commercial Vehicle Operations
CW	Corridor-wide
CWATIS	Corridor-wide Advanced Traveler Information System Project
CWATMS	Corridor-wide Advanced Transportation Management System Project
CWCVO	Corridor-wide Commercial Vehicle Operations Project
CWSIP	Corridor-wide Systems Integration Project
CWSPP	Corridor-wide Strategic Planning Project
DOIT	Department of Information Technology
DRI	Caltrans, Division of Research & Innovation (formerly NTR)
EAP	Evaluation Activity Plan
EMC	Emergency Management Center
EP	Evaluation Plan
FHWA	Federal Highway Administration
FSR	Feasibility Study Report
FTA	Federal Transit Administration
FTE	Full-Time Equivalent (one full-time employee)
GPRA	Government Performance and Results Act
GUI	Graphical User Interface
HAT	Highway Advisory Telephone service
HP	Hewlett-Packard
HQIT	Headquarters - Information Technology (division of Caltrans)
HTML	Hypertext Mark-up Language
IDL	Interface Definition Language
IPR	Intellectual Property Rights
ISSC	Information Systems Service Center (division of Caltrans)
ISTEA	Intermodal Surface Transportation Efficiency Act (of 1991)
ITS	Intelligent Transportation Systems
LAN	Local Area Network
MOU	Memorandum of Understanding

Abbreviations & Acronyms

MPO	Metropolitan Planning Organization
MTBF	Mean Time Between Failure
MTDB	Metropolitan Transit Development Board
NDA	Non-Disclosure Agreement
NET	National Engineering Technology Corporation
NTCIP	National Transportation Communications for ITS Protocol
NTR	Caltrans Division of New Technology & Research (now DRI)
OCTA	Orange County Transportation Authority
O&M	Operations and Maintenance
OS	Operating system (such as Windows™, Unix, Linux, et. Al.)
PBF	Parsons-Brinkerhoff Farradyne
PC	Personal Computer (Windows™-based)
QUALCOMM	Qualcomm Stadium Authority
RFP	Request for Proposals
RIWS	Regional Integrated Workstation
RTP	Regional Transportation Plan
RTPA	Regional Transportation Planning Agency
RWS	Remote Workstation
SANDAG	San Diego Association of Governments
SCAG	Southern California Association of Governments
SCAQMD	South Coast Air Quality Management District
SCPCSC	Southern California Priority Corridor Steering Committee
SDPD	San Diego Police Department
SIP	Systems Integration Plan
SOW	Statement of Work
TEA-21	Transportation Equity Act for the 21st Century
TMC	Transportation Management Center
TOC	Transportation Operations Center
TOSNET	Traffic Operations System Network
USDOT	United States Department of Transportation
VDS	Vehicle Detector Station
VMT	Vehicle Miles Traveled
VOS	Volume/Occupancy/Speed
WAN	Wide Area Network
XML	eXtensible Mark-up Language

Executive Summary

Background

As required by federal law, all Intelligent Transportation System (ITS) projects that receive federal funding must undergo an evaluation to help assess the costs and benefits of ITS. This document is one of 23 reports produced as part of the Southern California ITS Priority Corridor Showcase Program Evaluation to help planners and decision-makers at the federal, state and local levels make better-informed decisions regarding future ITS deployments. This report presents the experiences, costs, and lessons learned from Southern California's Mission Valley Event Management (MVEM) project. This project is also known regionally as the Mission Valley ATMS/ATIS Phase II project, and may be referred to as such in contributing documents.

In 1993, the U.S. Department of Transportation designated Southern California as one of four Priority Corridors in which ITS may have particular benefit. Southern California suffers from extreme traffic congestion, limited room for expanding transportation facilities, and above-average air pollution levels. The Southern California Priority Corridor is one of the most populated, traveled, and visited regions in the country, and consists of four adjoining regions:

- Los Angeles County and a part of Ventura County
- Orange County
- San Diego County
- Inland Empire (San Bernardino and Riverside Counties).

The ITS Showcase Program is one of several programs that have been implemented in Southern California's Priority Corridor to help aid mobility and mitigate traffic congestion and its associated environmental impacts. The Showcase Program consists of 17 ITS projects that collectively form a corridor-wide intermodal transportation management and information network between Los Angeles, Orange County, San Diego, and the Inland Empire. Each Showcase project deploys a piece of this corridor-wide ITS network, including regional Advanced Traveler Information Systems (ATIS), regional Advanced Transportation Management Systems (ATMS), and regional and interregional communications infrastructure. Eleven of the projects are regional in nature, while the remaining six are corridor-wide. The MVEM project is one of the eleven regional projects within the Southern California Priority Corridor ITS Showcase Program. The MVEM project was funded in its entirety by the Southern California Priority Corridor Showcase Program and was managed contractually by The City of San Diego and the San Diego Association of Governments.

The MVEM project is located in San Diego and its system provides real-time traffic management information regarding event related traffic congestion in three localities in and around the City of San Diego, including the vicinity of Qualcomm Stadium, La Jolla's Golden Triangle, and downtown San Diego. The project partners were tasked with

integration of legacy control systems, field device integration, software development, and the development of specialized computer workstations and servers to support the management of event traffic management.

Project partners for MVEM include:

- City of San Diego (Lead Agency)
- City of San Diego Police Department
- San Diego Stadium Event Management Center
- San Diego Metropolitan Transit Development Board (MTDB)
- San Diego Transit Corporation (SDTC)
- San Diego Trolley Inc. (SDTI)
- Caltrans District 11
- California Highway Patrol (CHP)
- Southern California ITS Priority Corridor
- PB Farradyne (Prime Contractor)
- NET Corporation (Sub Contractor)
- Katz Okitsu Associates (Sub Contractor)

Computer workstations provide traffic management information and allow management of certain local field devices located at Qualcomm Stadium, the City of San Diego Transportation Operations Center (TOC), and the San Diego regional Transportation Management Center (TMC). These workstations allow stadium personnel, San Diego Police Department officers, and city and state traffic and transportation managers, to view arterial segments through closed-circuit television cameras (CCTVs), display messages on Changeable Message Signs (CMSs), or record messages for broadcast on the local Highway Advisory Radio (HAR). The MVEM project is unique in that it demonstrates the coordination and cooperation of various state and local agencies on the design, development, deployment, and management of a common regional transportation management system project.

Evaluation Findings, Conclusions, and Recommendations

The Mission Valley Event Management project accomplished pioneering regional consensus on coordinated operations and shared field device control between agencies.

The MVEM project's most notable accomplishment is the formalized coordination, and cooperation between the agencies and organizations involved in the planning, deployment, and on-going operation of the MVEM systems and devices. The intent of the MVEM project was to develop and deploy a system for shared access and control of traffic management field devices, including a computer workstation with a common interface to allow communication between participating agencies and the devices that they use for traffic and event management and communication. This goal has been realized and is based on traffic management and operations protocols developed by the MVEM project partners. This document, known as the Mission Valley Event Traffic Management and Operations Procedure (ETMOP), September 2001, satisfied Tasks 5.1 and 5.2 of the MVEM contract and provided a basis for the ongoing, shared operation of

the MVEM system and devices through a Field Device Sharing Plan (Appendix A to the ETMOP). The ETMOP addresses event traffic management and operations protocols only, but provides a basis for other event management plans for traffic generating venues such as Qualcomm Stadium (a multi-purpose football and baseball stadium located in Mission Valley, approximately 6 miles east of downtown San Diego). Another important feature of the ETMOP is its Typical Stadium Traffic Management Scenarios and Event Management Interventions (Appendix B to the ETMOP). This section of the document describes five typical Qualcomm Stadium event scenarios and provides guidance regarding which agency should initiate a traffic management action, how communication will be established between other area traffic management agencies, and how those agencies will participate in supporting or continuing that traffic management activity. A copy of the ETMOP document is provided in Appendix E of this document.

The MVEM work tasks were accomplished within the expected timeframes, however, several notable events occurred that introduced delays in the overall project schedule.

Upon inception of the Mission Valley Event Management project and subsequent funding support through the Southern California Priority Corridor Showcase Program, a work plan was developed as required by the Federal Highway Administration as part of the Showcase Program requirements. This work plan contained a description of the project, its objectives, work tasks, deliverables, and an estimated schedule for completion of the tasks. A number of delays occurred during the course of the project that should be noted for future consideration in planning and scheduling similar projects. Primary project delays are attributable to the following:

- Integration of infrastructure deployment with other San Diego regional projects, including the deployment of fiber-optic cable as the communications backbone between each of the service area field devices and regional workstations.
- Delays in processing project scope or budget changes to accommodate technology changes (as long as 6 months)
- Longer than expected turn-around time for project deliverable document approvals (several weeks per document)
- Interpretation and clarification of the MVEM system's functional requirements.
- Southern California Priority Corridor Steering Committee processing of approvals of run-time licenses from IONA.
- Software development delays based on difficulty procuring documentation for interface with existing CMS from product vendor.
- Large number of unplanned, but crucial, coordination meetings with project partners and external project vendors.

The MVEM provided the initial funding and tasking to begin a broader deployment of integrated workstations that share regional transportation information, device status and control.

One of the purposes of the MVEM project was the development and deployment of a computer workstation that could be connected to a wide-area network that would allow

cities and agencies within the San Diego region to share transportation system management information. This wide-area network, the Intermodal Transportation Management System (IMTMS) regional network, provides a distributed architecture through the use of several Intertie servers that facilitate the sharing of transportation system management data and information. The workstation was architected with the needs of the entire region as a basis for the design. It allows the agencies and cities to view other agency's traffic signal devices, changeable message signs, closed circuit television cameras, and – depending upon agreements between the agencies – share control of these field devices on a single integrated user screen. The funding for MVEM accomplished this goal in developing the integrated workstation (IWS), which is the prototype for the regional integrated workstation (RIWS). The first instances of the IWS are located at the San Diego TOC, the Caltrans/CHP regional TMC, and Qualcomm Stadium to support the Mission Valley event traffic management needs.

In the future, the RIWS is expected to be deployed to other city and other agency transportation and traffic management centers around the San Diego region. This deployment will further expand the capabilities of the IWS and RIWS to participating jurisdictions, and allow connection to the regional network.

Conclusions and Recommendations

The MVEM project accomplished its initial goal and is poised to continue contributing to the regional vision of connected transportation and traffic management systems through subsequent builds of the RIWS. The MVEM was an important part of a much larger regional picture of transportation system management. This project is tightly connected to several other projects occurring in parallel in San Diego, including the continued development of the IMTMS regional network. Each of these projects brings a component on-line that supports the development and deployment of this regional transportation management system.

The continued success of the MVEM system and its successors will depend largely on the support of regional transportation agency leaders and their willingness to strongly encourage the integration of the new information systems technologies into the daily transportation management procedures at the operator level. Conversely, future builds of the RIWS must work closely with individuals responsible for daily operations to ensure that the design of the information system, and associated user interface, expedites the accomplishment of their tasks, simplifies and improves upon current operating procedures, and integrates well into the operator's workplace culture.

1 Introduction

1.1 Purpose and Scope of this Report

As required by federal law[1], all Intelligent Transportation System (ITS) projects that receive federal funding must undergo an evaluation to help assess the costs and benefits of ITS. The information provided in this report is intended to help planners and decision-makers at the federal, state and local levels make better-informed decisions regarding future ITS deployments based on the experiences of Southern California's Mission Valley Event Management (MVEM) project.

This document is one of 23 reports produced as part of the Southern California ITS Priority Corridor Showcase Program Evaluation, and covers only the events and findings resulting from the MVEM evaluation. The complete findings from the Showcase Program Evaluation are found in the following collection of documents:

Document Type/Title	Date	Document Number
17 Individual Project Evaluation Reports		
Corridor-wide ATIS Project Report	7/16/2003	65A0030/0033
Corridor-wide ATMS Project Report	10/11/2004	65A0030/0049
Corridor-wide CVO Project Report	10/29/2004	65A0030/0051
Corridor-wide Rideshare Project Report	11/1/2004	65A0030/0048
Corridor-wide Strategic Planning Project Report	10/29/2002	65A0030/0028
Fontana-Ontario ATMIS Project Report (draft)	11/11/2004	65A0030/0047
IMAJINE Project Report	3/17/2003	65A0030/0029
IMTMC Project Report	11/2/2004	65A0030/0054
InterCAD Project Report	4/2/2003	65A0030/0030
Kernel Project Report	5/30/2003	65A0030/0031
LA ATIS Project Report	7/18/2003	65A0030/0038
Mission Valley ATMIS Project Report	**11/12/2004**	**65A0030/0050**
Modeshift Project Report	10/28/2004	65A0030/0052
OCMDI Project Report	2/20/2004	65A0030/0040
Traffic Signal Integration Project Report (draft)	10/25/2004	65A0030/0055
Transit Mgt System Project Report (draft)	10/19/2004	65A0030/0053
TravelTIP Project Report	6/3/2003	65A0030/0036
5 Cross-Cutting Evaluation Reports		
System Performance Cross-Cutting Report	11/11/2004	65A0030/0056
Costs Cross-Cutting Report	TBD	65A0030/0057
Institutional Issues Cross-Cutting Report	11/12/2004	65A0030/0058
Information Management Cross-Cutting Report	TBD	65A0030/0059
Transportation System Impacts Cross-Cutting Report	TBD	65A0030/0060
Final Summary Evaluation Report		
Showcase Program Evaluation Summary Report	TBD	65A0030/0061

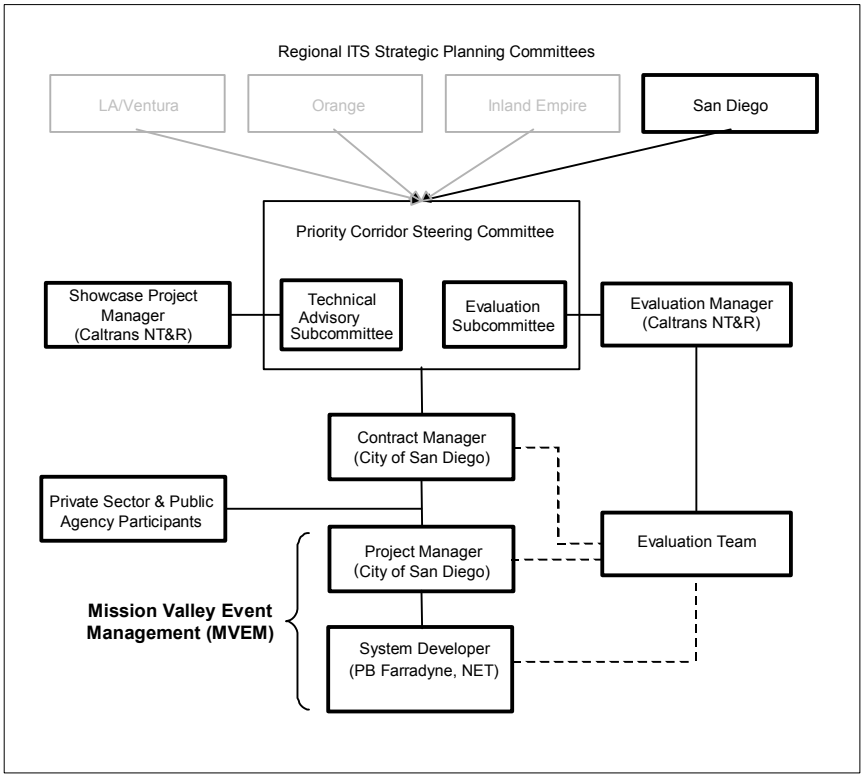
"TBD" indicates a future deliverable that is not yet available.

1.2 Evaluation Design and Approach

The findings outlined in this report are based on over six years of personal observations at project meetings, reviews of released project documents and agency memos, analysis of collected quantitative data, as well as formal and informal interviews and discussions with project partners.

The evaluation is responsive to the needs and suggestions of the Priority Corridor's Evaluation Subcommittee, which reports to the Priority Corridor's Steering Committee. As shown in Exhibit 1, both committees are comprised of stakeholders from the federal, state, and local levels.

Exhibit 1 – Management Structure and Organization of the Showcase Program and the MVEM Project



The Steering Committee's member agencies reflect wide representation from the region in terms of federal and state highway agencies, public safety, cities and counties, transit, air quality and regional planning entities, including:

- California Highway Patrol (CHP)
- Caltrans, Division of Traffic Operations (headquarters)*
- Caltrans, District 7*
- Caltrans, District 8*

- Caltrans, District 11*
- Caltrans, District 12
- City of Irvine*
- City of Los Angeles Department of Transportation (LADOT)
- City of San Diego
- Federal Highway Administration (FHWA)*
- Federal Transit Administration (FTA)
- Los Angeles County Metropolitan Transportation Authority (MTA)
- Orange County Transportation Authority (OCTA)
- Riverside County Transportation Commission (RCTC)
- San Bernardino Association of Governments (SANBAG)
- San Diego Association of Governments (SANDAG)
- South Coast Air Quality Management District (SCAQMD)
- Southern California Association of Governments (SCAG).

* Indicates an Evaluation Subcommittee member

The Showcase Program's Evaluation Design is based on a set of evaluation Goals and supporting Objectives and Measures that were developed by the Evaluation Team in partnership with federal, state and local stakeholders, and documented in the "Showcase Program Evaluation Approach" in 1998. Each individual Showcase project is evaluated based on an applicable subset of these Goals, Objectives, and Measures in order to help ensure that summary evaluation results can be aggregated from across the multiple Showcase project evaluations. The Showcase Program's five evaluation Goals include:

- Evaluate System Performance
- Evaluate Costs
- Evaluate Institutional Issues and Impacts
- Evaluate the Use and Management of Transportation/Traveler Information
- Evaluate Transportation System Impacts.

As MVEM evolved, project-specific refinements to the evaluation design were documented in a high-level Evaluation Plan (EP) and a detailed Evaluation Activity Plan (EAP). In general, the EP describes the project and/or system under evaluation, and lays the foundation for further evaluation activities by developing consensus among the Evaluation Subcommittee and project partners as to which of Showcase's evaluation Goals, Objectives, and Measures best apply to the project.

As the project matured, and after the EP had been approved, an EAP was developed to plan, schedule, and describe specific activities (interviews, surveys, etc.) and step-by-step procedures for conducting the evaluation. Data collection began after both plans had been reviewed and subsequently approved by the Evaluation Subcommittee and the project's partners.

1.3 Organization of this Report

The MVEM Evaluation Report provides a background description of the Southern California Priority Corridor and the transportation challenges facing San Diego County. This is followed by descriptions of the Showcase Program and the MVEM project, including a detailed technical description. The evaluation itself is subdivided and ordered into the five topic areas described below:

System Performance — provides important benchmark information regarding system availability, reliability, scalability and compatibility. The evaluation quantifies those items and could be used to identify needed improvements and help develop specifications for future systems.

Cost — provides important benchmark information regarding funding sources, software licensing, development costs, costs to re-deploy elsewhere or expand the system, and operations and maintenance (O&M) costs. This report includes an estimate of how much it might cost to re-deploy MVEM "from scratch" elsewhere in the State, and also looks at the incremental costs for integrating additional partner agencies and/or traveler information kiosks into the existing system.

Institutional Impacts — provides important information regarding the administrative, procedural and legal impacts resulting from the deployment of MVEM. Such impacts include changes in operator workloads, responsibilities and job turnover rates, as well as changes and limitations of agency-wide policies, procedures and guidelines.

Transportation & Traveler Information Management — provides important benchmark information on system usage and user acceptance (by both agency operators and the general public). This report provides both quantitative and qualitative findings on those items and can be used to identify user demand, needed improvements and potential areas of future growth.

Transportation System Impacts — provides important information regarding MVEM's impacts on transit usage, traffic congestion, air quality, and traffic safety.

The report concludes with a summary, final remarks and recommendations for next steps. Several appendices contain supporting documentation such as technical designs and copies of evaluation data collection instruments (blank questionnaires and survey).

1.4 Privacy Considerations

Some of the information acquired in the interview and discussion process could be considered sensitive and has been characterized in this report without attribution. The Evaluation Team has taken precautions to safeguard responses and maintain their confidentiality. Wherever possible, interview responses have been aggregated during analysis such that individual responses have

become part of a larger aggregate response. The names of individuals and directly attributable quotes have not been used in this document unless the person has reviewed and expressly consented to its use.

1.5 Constraints & Assumptions

The MVEM evaluation is subject to the following constraints and assumptions:

- The project's consultant was not required to disclose actual project expenses, so the project's cost was based on the fixed price budget stipulated in the MVEM contract and its amendments. The budget reflects the expenses and costs paid by the client agency, but not necessarily the actual detailed costs for goods and services comprising the project.

1.6 Project Background

1.6.1 The Southern California Priority Corridor

In 1993, the U.S. Department of Transportation designated Southern California as one of four Priority Corridors in which Intelligent Transportation Systems (ITS) could have particular benefit. The Southern California Priority Corridor, illustrated in Exhibit 2, is one of the most populated, traveled, and visited regions in the country. Roughly two-thirds of the state's population – about 20 million people – resides in or around the Southern California Priority Corridor. It suffers from extreme traffic congestion, limited room for expanding transportation facilities, and above-average air pollution levels.

The Southern California Priority Corridor consists of four distinct regions that correspond with the four Southern California Caltrans districts:

- Los Angeles/Ventura (Caltrans District 7)
- Orange County (Caltrans District 12)
- San Diego (Caltrans District 11)
- Inland Empire (Caltrans District 8)

Exhibit 2 – The Southern California Priority Corridor and Vicinity

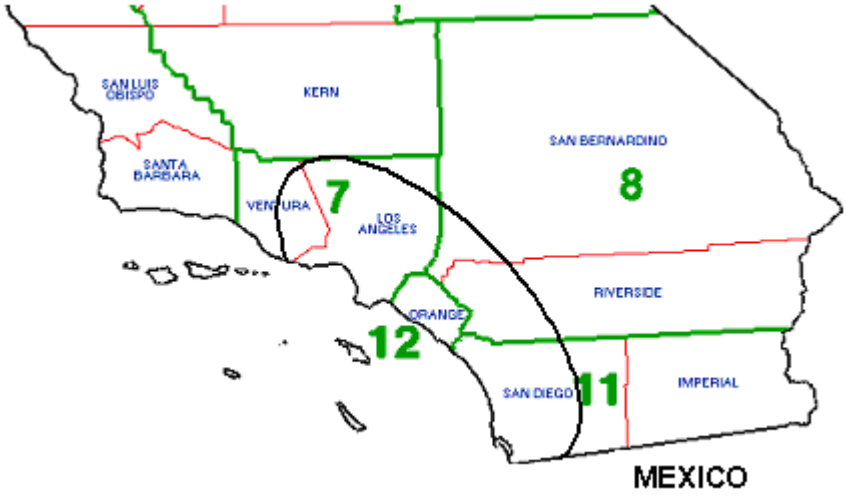


Exhibit 3 – Population and Number of Registered Vehicles by County

County	Population[2] (as of 1/1/2003)	Registered Vehicles[3]* (as of 12/31/2002)	Caltrans District
Los Angeles	10 million	6.7 million	7
Orange	3 million	2.2 million	12
San Diego	3 million	2.3 million	11
San Bernardino	1.8 million	1.3 million	8
Riverside	1.7 million	1.2 million	8
Ventura	0.8 million	0.7 million	7
Imperial	0.15 million	0.1 million	11
Total	**20.5 million**	**14.5 million**	

*Includes autos, trucks, and motorcycles. Trailers not included.

1.6.2 The Southern California Priority Corridor's ITS Showcase Program

The ITS Showcase Program is one of several programs that have been implemented in Southern California's Priority Corridor to help aid mobility and mitigate traffic congestion and its associated environmental impacts.

Exhibit 4 lists the 17 ITS projects in the Showcase Program. These projects collectively form a corridor-wide intermodal transportation management and information network between Los Angeles, Orange County, San Diego, and the Inland Empire. Eleven of the projects are regional in nature, while the remaining six are corridor-wide in scope.

The MVEM project became one of the 17 projects that comprise the Southern California Priority Corridor ITS Showcase Program. The 17 Showcase projects are listed below by region. Eight of the projects, including MVEM, were fast-tracked and designated "Early Start" projects because of their importance as base infrastructure and potential to act as role models for the rest of the

Showcase Program. The Showcase funded portion of the MVEM project was completed and acceptance tested in July 2003. Additional project phases and functionality are planned for the near future and will be funded through other sources.

Exhibit 4 – The 17 Showcase Projects and their Status as of September 2004

Project	RFP Issued	Contractor Selected	Contract Executed	Project Underway	Project Complete
Corridor-wide					
Scoping & High Level Design (Kernel)*	✓	✓	✓	✓	✓
Strategic Planning/Systems Integration	✓	✓	✓	✓	✓
CVO🗎					
ATIS	✓	✓	✓	✓	✓
ATMS🗎					
Rideshare	✓	✓	✓	✓	✓
Los Angeles Region					
IMAJINE*	✓	✓	✓	✓	✓
Mode Shift*	✓	✓	✓	✓	✓
LA ATIS	✓	✓	✓	✓	✓
Inland Empire Region					
Fontana-Ontario ATMIS	✓	✓	✓	✓	✓
Orange County Region					
TravelTIP*	✓	✓	✓	✓	✓
OCMDI	✓	✓	✓	✓	✓
San Diego Region					
InterCAD*	✓	✓	✓	✓	✓
Mission Valley Event Management*	✓	✓	✓	✓	✓
IMTMS/C (ATMSi)*	✓	✓	✓	✓	
Traffic Signal Integration (RAMS)	✓	✓	✓	✓	
Transit Management System*	✓	✓	✓	✓	

* Indicates an "Early Start" project.

🗎 CWCVO and CWATMS do not yet have approved work plans.

2 Project/System Technical Description

High-level Concept of Operations Overview

The primary concept for the MVEM project, as developed by the City of San Diego and the contracted system developers, was to integrate the operation of various Advanced Transportation Information Systems (ATIS) and Advanced Transportation Management Systems (ATMS) devices within the City of San Diego Transportation Operations Center (TOC), provide access to these devices from Stadium Event Management Center (EMC), and provide for data exchange between the City of San Diego TOC, the Qualcomm Stadium EMC, and the Caltrans/CHP Regional TMC. The project concept of operation was developed in June 2000 and includes this description of the following capabilities:

- The City of San Diego transportation and traffic management staff are able to monitor and control their field devices, CCTV cameras, and CMSs from one integrated workstation, and are able to view arterial traffic congestion on the same workstation.
- The City and Caltrans are able to share congestion data, CMS status, CCTV status, and incident data with each other subject to conditions and limits defined in the ETMOP, a document developed as part of this project. The City's congestion data includes volume, derived speed and occupancy information in real-time from the City's main arterials. The Caltrans data includes volume, occupancy and derived speed information from main line freeway loops, on-ramp, and off-ramp loops as well as available information regarding incidents on the freeways.
- The City and Caltrans are able to monitor and share control of each other's CMS and CCTV devices based on policies defined in the ETMOP. The CMS monitoring will include sign status including current message displayed. The CCTV monitoring includes real time video imagery.
- The City is able to perform above functions from the City TOC and Stadium.
- Caltrans is able to perform above functions from Caltrans/CHP Regional TMC.
- City TOC, EMC, and Regional TMC staff are able to coordinate their operations during special events and recurring congestion affecting both surface streets and freeways. This is accomplished through the use of response plans, which were developed as part of this project.

The remodeling and technology update of the San Diego City Transportation Operations Center (TOC) was included in the MVEM project tasks. The center includes a command and control room and a computer, network, and peripheral clean room. The command and control room includes a large screen display and six smaller monitors for simultaneous viewing of the region's closed circuit television images. The large screen display can also server as a monitor for viewing the Integrated Workstation application. The command and control room is shown in Exhibit 5.

Exhibit 5 – City of San Diego Transportation Operations Center

(Command & Control Room, and Clean Room with Servers)

Exhibit 6 – MVEM Integrated Changeable Message Sign

(Westbound F Street, Downtown San Diego)

The workstations deployed at Qualcomm Stadium have been placed in the stadium manager's office and in the Qualcomm Stadium Event Management Center (EMC). SDPD personnel who work events at the stadium are able to use the workstation located in the EMC. The EMC is located above the Plaza Level of the Stadium. The intersection

shown in Exhibit 7 is one of many monitored by CCTV in the Qualcomm Stadium vicinity.

Exhibit 7 – Qualcomm Stadium

(Looking south, intersection of Mission Village Road & Friars Road)

MVEM System Configuration Summary

The MVEM Project has implemented a traffic management system that includes the following hardware, software, network, and field device components. A complete description of each of the system component specifications is included in Appendix A, MVEM System Configuration Detailed Specifications.

System Component	Component Description and Function
Intertie Server (IS)	Sun Ultra 10 Workstation computer running a UNIX operating system. Provides computer server process-to-process functions for the Integrated Workstations and the Mission Valley event management applications deployed in the San Diego region.
Integrated Workstation (IWS)	Compaq Presario PC running a Windows 2000 operating system. Integrated workstations are intended to be located at event centers, trip generation points and transportation management centers. Currently the workstations are located at San Diego Transportation Operations Center, Qualcomm Stadium EMC, and the Caltrans/CHP Regional Transportation Management Center. The primary function of the workstation is to provide a platform for the Mission Valley application GUI and allow users to monitor traffic conditions and provide information to motorists using a single workstation and computer application.
Closed Circuit Television (CCTV)	Cohu and Baxall closed circuit television cameras, controllers and video switches. The CCTV system displays live images of roadway segments at various locations around the San Diego area. CCTV locations are chosen based on frequency and intensity of event related traffic congestion and recurring commuter congestion.
Changeable Message Sign (CMS)	American Electronic Systems and McCain changeable message signs capable of providing messages to travelers and commuters along roadway segments where information may be required to warn motorists of event related and non-event related roadway congestion or travel conditions.
Highway Advisory Radio (HAR)	Recorder and AM radio transmitter system for broadcasting traffic and event information to motorists and travelers in the vicinity of event generation locations such as Qualcomm Stadium.
TOSNET	Traffic Operations System Network. Caltrans District 11 has constructed network based on Gigabit Ethernet technology. The TOSNET supports many of the field elements in District 11, including CCTV, CMS and VDS/ramp meters. This network is in the midst of a multi-phase construction plan. The TOSNET is central to Caltrans-Field device communications.

System Component	Component Description and Function
Caltrans Fiber Optic Cable Infrastructure.	Data is being moved out onto this infrastructure via Gigabit Ethernet switches to other MVEM facilities at the SD City TOC and Qualcomm Stadium. The point to point link between Caltrans D11 and the City of San Diego was accomplished through the use of a pair of Gigabit Ethernet Switches to transmit video and data over the same link. The link from the San Diego TOC to the Stadium is a fiber optic link also but uses an Ethernet modem at each end; this is a data link only. A separate fiber optic video link transmits the CCTV images to the stadium. Caltrans Fiber Optic Cable infrastructure runs along with the interstate freeway system. City goes to Washington/163 – splice cabinet at this point where the city fiber network is spliced into the Caltrans fiber infrastructure.
City of San Diego Fiber Optic Network (Stops at Freeway)	The City of San Diego is in the midst of building out its extensive fiber optic network in the Central Business District, Mission Valley, North City West (Golden Triangle area) and South Bay (as part of the South Bay Multi-Jurisdictional Fiber Project). Most of the City's fiber network is Single Mode but two major segments are Multi-Mode: from the Stadium to Washington Street and from Washington Street to the City Transportation Operations Center (TOC) downtown. These two segments will be converted to single mode as part of the MVEM Project. The fiber architecture is point-to-point with some path redundancy. The fiber network connects the Qualcomm Stadium Event Management Center (EMC) and Stadium Manager's Office to the field infrastructure around the stadium and to the TOC downtown. The TOC will be the hub for all of the City's fiber network segments and thus will control all city ITS infrastructure, not just the Mission Valley area. The fiber network supports both data and video.
Video Display Wall	Display units integrated into the City TOC specifically dedicated to workstation, server, and CCTV image display. Operator is able to select a camera and display the image on the large screen plasma or one of the six video monitors surrounding the large screen.

Workstation/Server Architecture and System Design Description

The MVEM system is a client server architecture connected via a fiber optic WAN and supported by leased, cable, and wireless communications services for CCTVs, CMSs, and HAR devices.

The MVEM system developers designed the system as a peer-to-peer architecture, extending the client/server model with the addition of distributed object-oriented technology. The peer-to-peer architecture removes the traditional boundaries for server and workstation, so that any node on the network can be a client or a server or both. Server objects connect to any number of client processes, giving the City of San Diego and Caltrans flexibility to add other agencies without making changes to the software.

The shared systems incorporate standard National Transportation Communications ITS Protocol (NTCIP) interfaces between the city server and the CMSs.

Internal to the San Diego City TOC, the Intertie Server implements the needed processes that manage the common object request broker (CORBA) objects, including field devices such as CCTV and CMS objects. A CORBA common service, called the Naming Service tells the Object Client where to find a field device object when a user makes a request for a certain field device through the MVEM GUI. This Naming Service references local cameras, remote cameras, and the sharing of cameras. Caltrans can access City cameras when permitted by another CORBA common service, called the Security Service. An additional potential function of the Intertie Server may be to provide Caltrans with real-time arterial vehicle detection system data in the future and event data objects also. The vehicle detection system data would be wrapped into read-only objects and sent to Caltrans.

Within the Caltrans/CHP Regional TMC, the center-to-center software is implemented in their Intertie Server. For District 11, the Intertie Server is a component of the IMTMS project. The CORBA technology allows computers at Caltrans and at the City to communicate. Minimal hardware and software changes are needed, as the City clients can talk directly to existing Caltrans CCTV, CMS, VDS and Event objects. To aid in security and control of device management, these objects are read-only and are updated as changes are detected in the field.

The CORBA Common Services mentioned above were initially part of the Showcase Kernel Services to be deployed in the San Diego region. However, the Showcase Kernel services continue to evolve and change with technology updates and associated architecture enhancements, thus creating a more fluid environment for development of the regional systems. The architecture for the project remains based on Showcase standards.

Exhibit 8 – Simplified MVEM Architecture

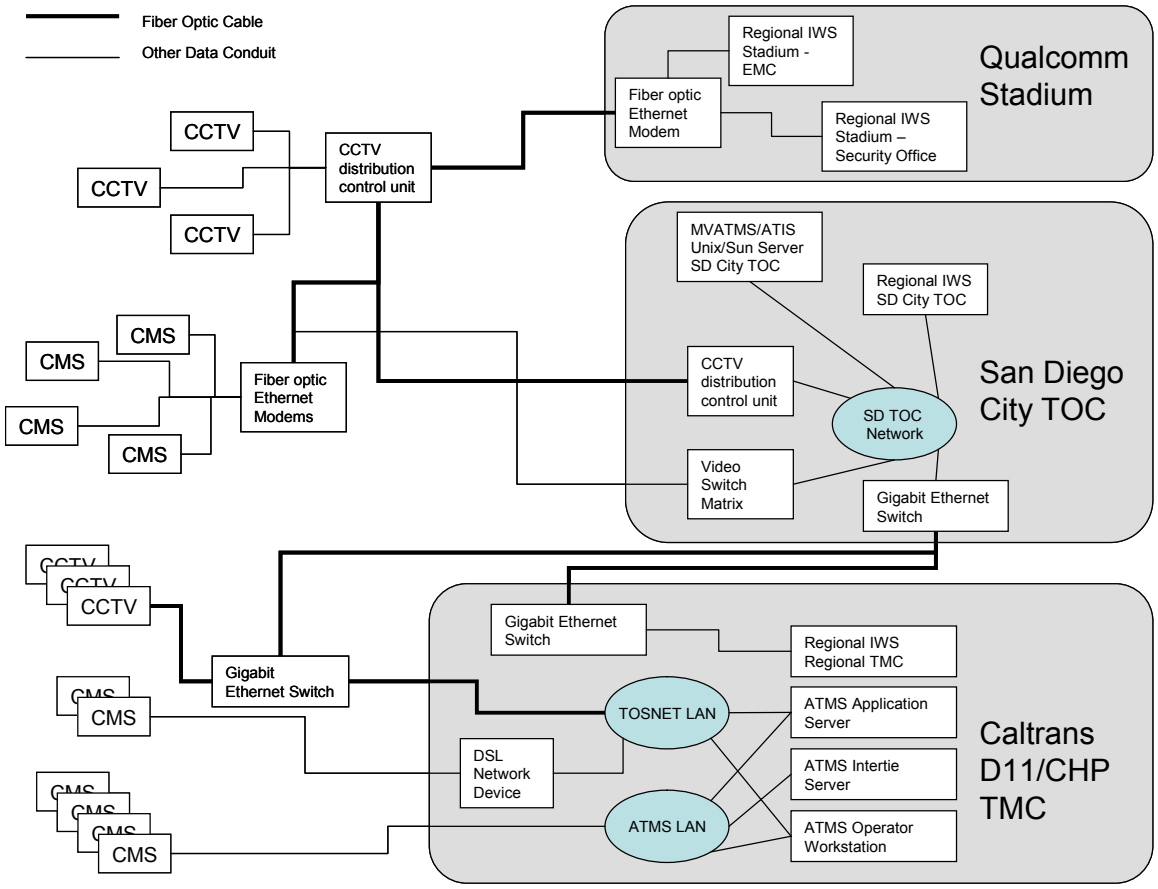


Exhibit 9 – Data flows for between the regional workstations and field devices

Workstation Location	Field Element	Field Element Owner	Data to/from workstation
Caltrans District 11 TMC	SD CCTV	San Diego City	Camera selection and control commands
Caltrans District 11 TMC	SD CMS	San Diego City	Selection and control commands
Caltrans District 11 TMC	Qualcomm CCTV	San Diego City	Camera selection and control commands
Caltrans District 11 TMC	Qualcomm CMS	San Diego City	Selection and control commands
San Diego City TOC	Qualcomm CCTV	San Diego City	Camera selection and control commands
San Diego City TOC	Qualcomm CMS	San Diego City	Selection and control commands
San Diego City TOC	CT CCTV	Caltrans District 11	Video images
San Diego City TOC	CT CMS	Caltrans District 11	Sign panel display
Qualcomm Stadium	CT CCTV	Caltrans District 11	Video images
Qualcomm Stadium	CT CMS	Caltrans District 11	Sign panel display
Qualcomm Stadium	SD CCTV	San Diego City	Camera selection and control commands
Qualcomm Stadium	SD CMS	San Diego City	Selection and control commands

The following figures illustrate the data flows between the entities participating in the MVEM project.

Exhibit 10 – Data flows between Caltrans District 11 and MVEM regional field devices.

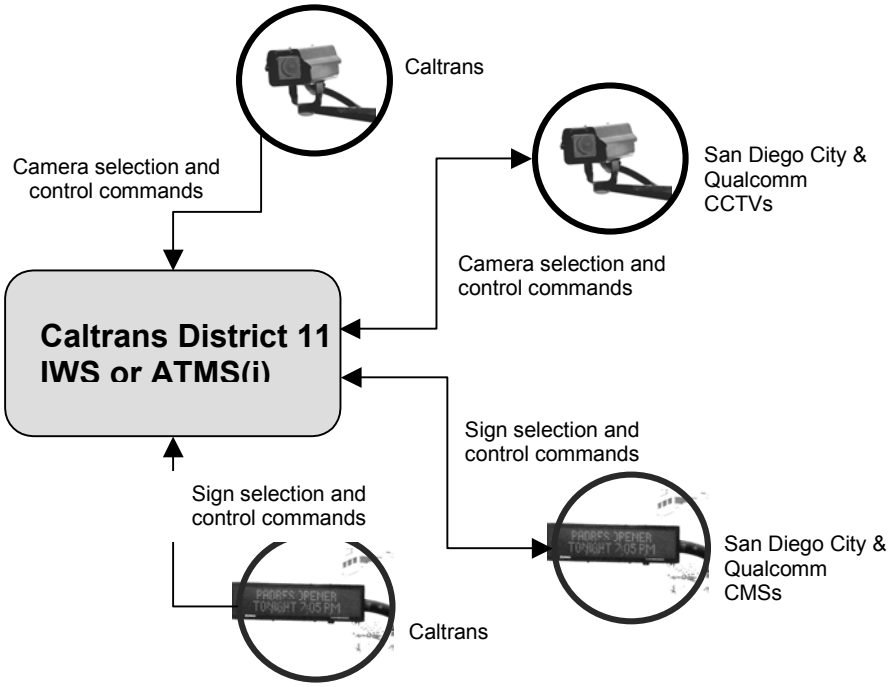


Exhibit 11 –Data flows between San Diego City TOC Server and RIWS and regional field devices.

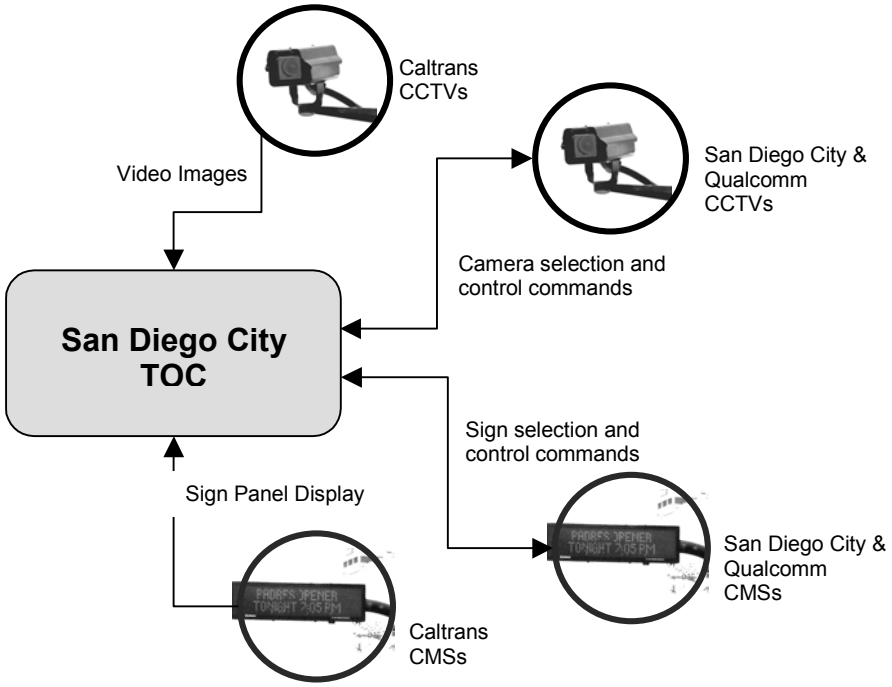
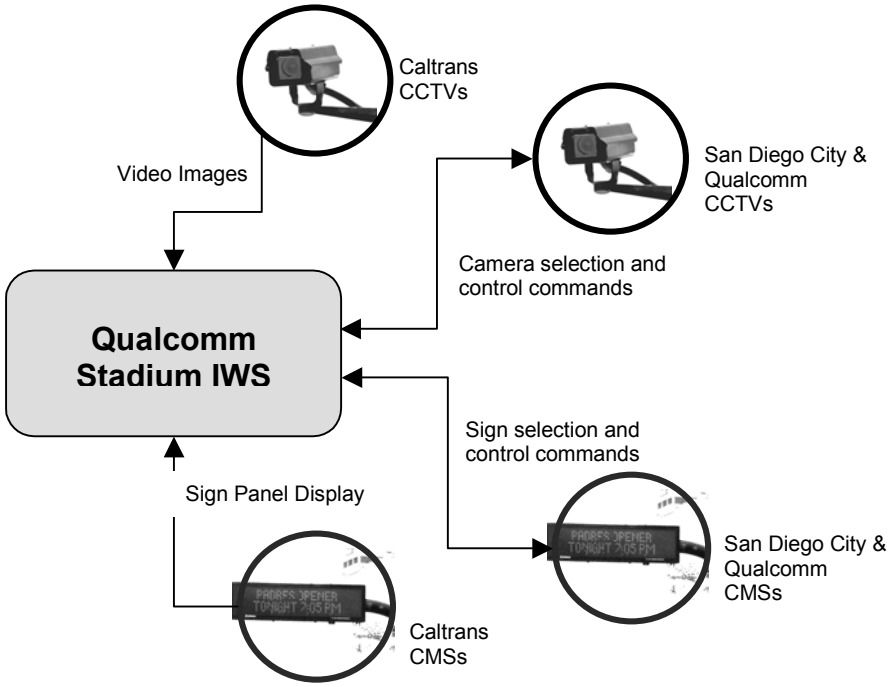


Exhibit 12 –Data flows between Qualcomm Stadium RIWS and regional field devices.



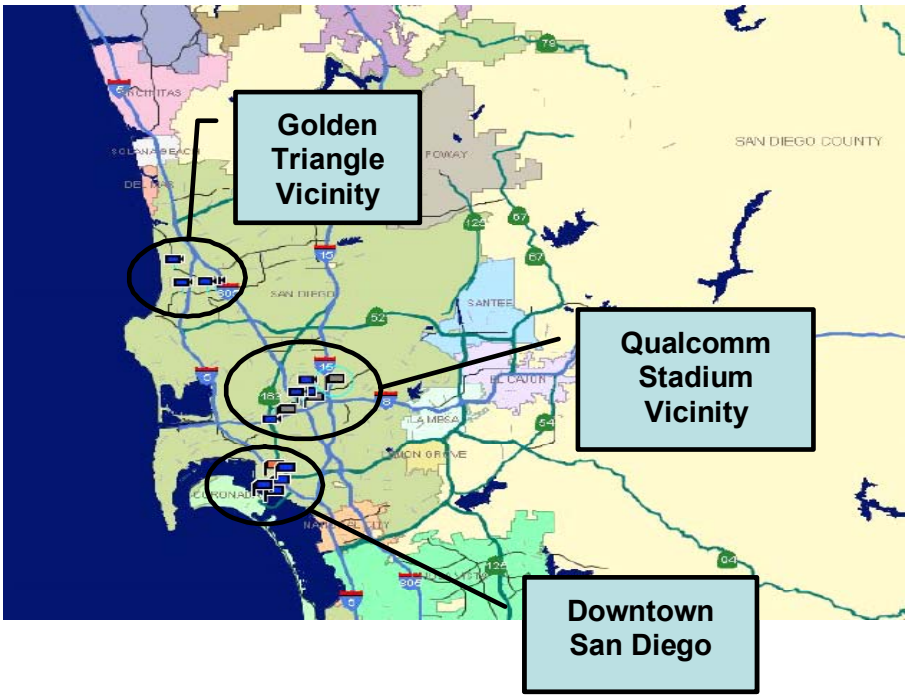
San Diego TOC highway advisory radio messages and control are local only to the TOC; a separate application is available on the desktop on the integrated workstations for management of this function.

Geographic Coverage and Field Device Locations

The MVEM project installed or connected to field devices in three primary vicinities within the San Diego City jurisdiction: Downtown San Diego, Qualcomm Stadium Vicinity, and the Golden Triangle vicinity.

Each of the clusters of current field devices is depicted at the regional level in Exhibit 13. The field device locations were chosen based on traffic volumes, and commuter and event-related congestion along the included corridors.

Exhibit 13 – Vicinities of current MVEM Project Field Devices in the San Diego Region



For each vicinity depicted above, the tables that follow contain the locations of each of the field devices deployed in the MVEM project, and include the type of device, specific location, device manufacturer, operational status, and associated remarks regarding the device.

Qualcomm Stadium Vicinity:

Device Type	Location	Manufacturer	Operational	Remarks
CMS	Friars Rd west of River Run Dr	AES	Yes	Existing, Owned and Operated by the City of San Diego. Integration under MVEM project. [1]
	Friars Rd east of Gill Village Dr	AES	Yes	"

[1] Changeable Message Signs were previously programmed at the location of the sign using a laptop computer to plug into a junction box and program the sign manually on-site.

Device Type	Location	Manufacturer	Operational	Remarks
	Friars Rd east of Mission Village	McCain	Yes	"
	Friars Rd west of Northside Dr	McCain	Yes	"
CCTV	Friars Road @ Mission Village	COHU	Yes	"
	Friars Road west of Frazee Rd	COHU	Yes	"
	Friars Road @ Qualcomm Way	COHU	Yes	"
HAR	Qualcomm Way @ Camino Del Rio N	LPB Comm	Yes	Existing system, upgraded to a digital system under MVEM

Golden Triangle Vicinity:

Device Type	Location	Manufacturer	Operational	Remarks
CCTV	La Jolla Village Dr. @ Town Centre Dr	COHU	Yes	Existing, Owned and Operated by the City of San Diego. Integration under MVEM project
	Genesee Ave @ Torrey Pines Rd	COHU	Yes	"
	Genesee Ave. @ La Jolla Village Dr	Iteris Vantage	Yes	"
	La Jolla Village Dr @ Villa La Jolla Dr	Iteris Vantage	Yes	"
CMS	None			
HAR	None			

.

Downtown San Diego:

Device Type	Location	Manufacturer	Operational	Remarks
CMS	F St between 14th and 15th	AES	Yes	Existing, Owned and Operated by the City of San Diego. Integration under MVEM project.
	10th Av between A St and B St	AES	Yes	"
	Front S between Cedar and Beech	AES	Yes	"
	Harbor Dr between Front and First	AES	Yes	"
	Harbor Dr south of Eighth Av	AES	Yes	Owned by Convention Center, Operated by City of San Diego.
CCTV	None			
HAR	None			

Freeway System Devices:

Device Type	Location	Manufacturer	Operational	Remarks
CMS	Freeway CMS devices on Interstate Highway and State Highway right of way (see ETMOP) within the District 11 region.	Farranti-Packer	Yes	Existing, Owned and Operated by the State of California, Department of Transportation, District 11.[2]
CCTV	All active cameras within the District	Baxall	Yes	"

[2] Connection to IMTMS Freeway Management System and ultimately to the ATMSi

Mission Valley Integrated Workstation Graphical User Interface

The Integrated Workstation (IWS) Graphical User Interface (GUI) is map-based with dynamic objects representing CCTV and CMS field devices, both local and remote. In terms of the GUI, dynamic objects mean that device or event icons can freely come, go, and change status in real-time, dependent on the actual device objects connected to the GUI and their operating condition and status. This gives flexibility to the display, and allows many kinds of dynamic objects to be added.

Exhibits 14 through 16 are screenshots of the Mission Valley Application GUI running on the Integrated Workstations.

Exhibit 14 – Mission Valley Integrated Workstation Field Elements

(San Diego Regional View)

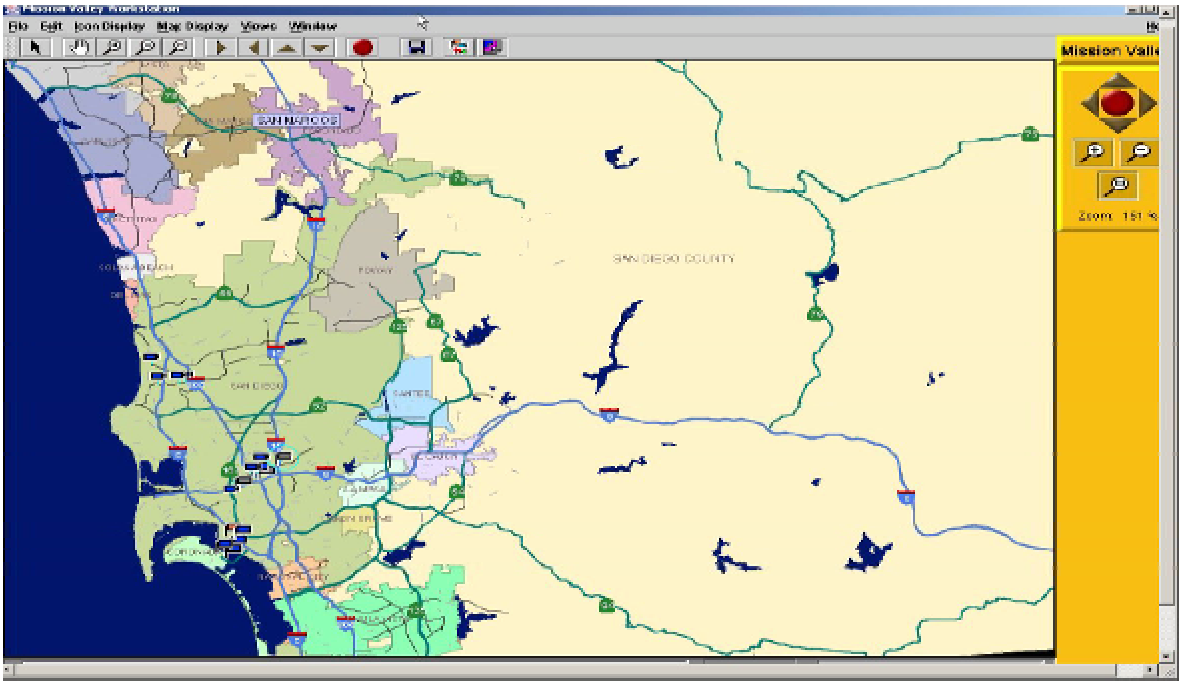


Exhibit 15 –Field Element Locations (Qualcomm Stadium Vicinity View)

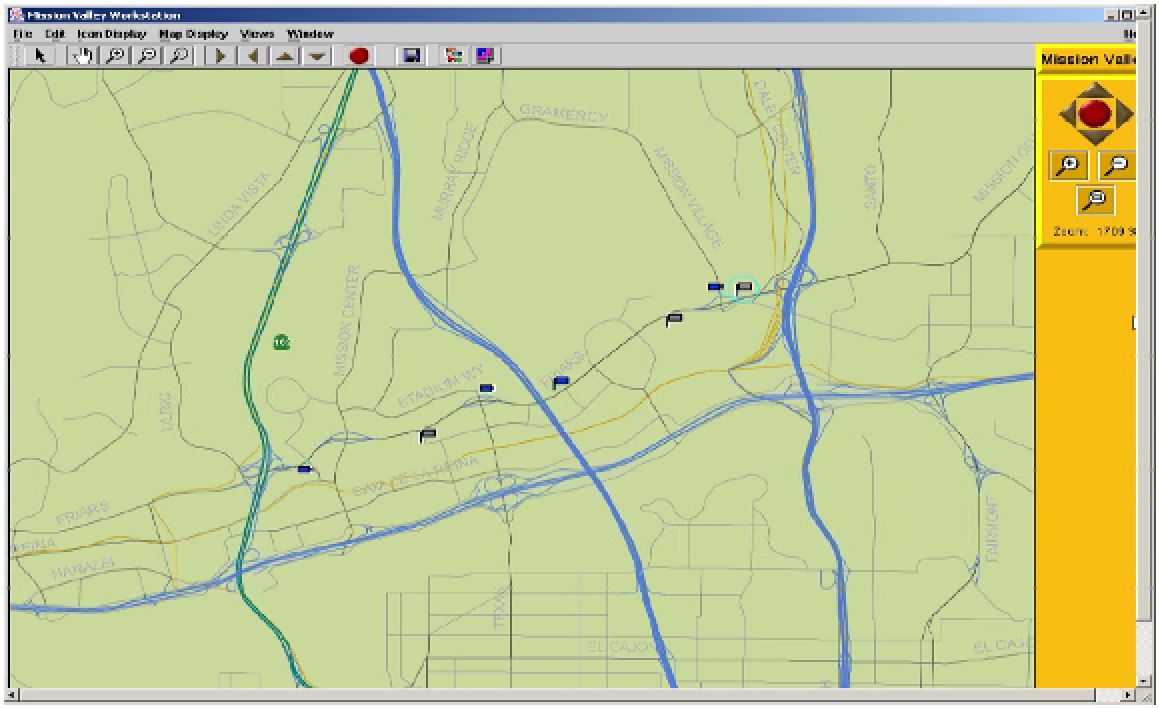
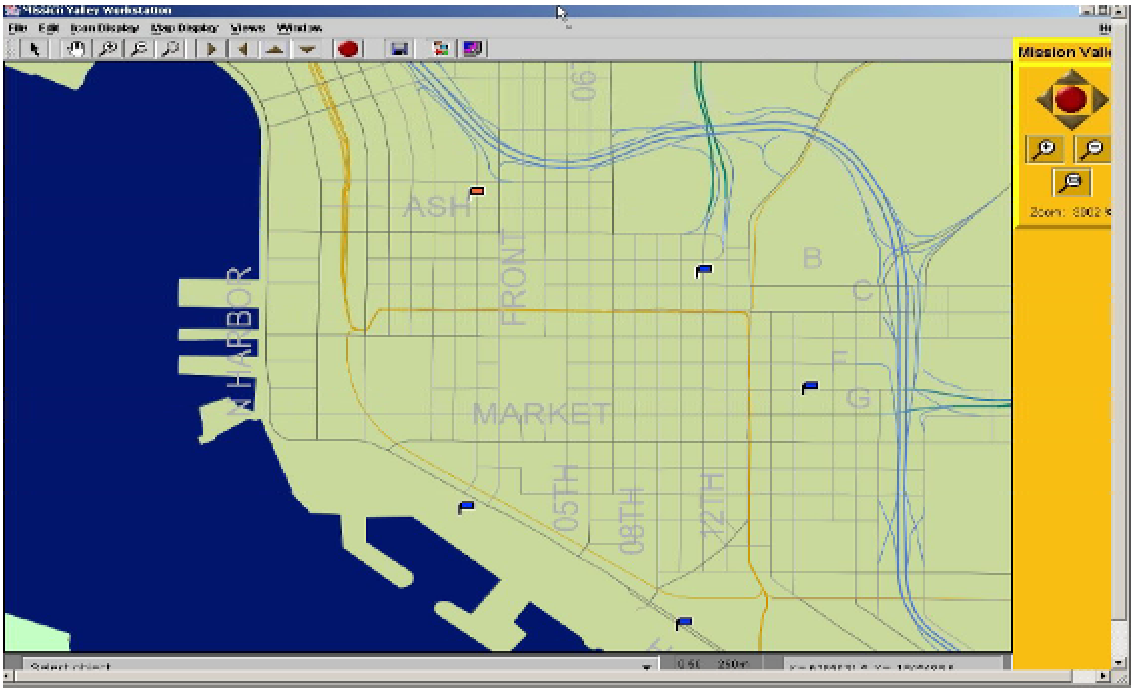


Exhibit 16 –Field Element Locations (Downtown San Diego View)



3 System Performance Evaluation

3.1 The Project/System Development Process and Timeline

The MVEM project is a multi-phase system development and deployment effort. Phase II of the project was the only part funded through the Showcase Program. The contract for Phase II of this effort, known contractually as the Mission Valley ATMS/ATIS – Phase II System, was issued as a firm-fixed price contract through the City of San Diego to PB Farradyne, Inc. on April 1, 1999. The total contract value was $392,800. All contract management activities were the responsibility of the City of San Diego, and the project technical management has been led by the City of San Diego, in cooperation with Caltrans District 11, San Diego Police Department, Qualcomm Stadium, and the California Highway Patrol. The original contract included the top-level Tasks shown in Exhibit 17.

Exhibit 17 –MVEM Project Tasks and Subtasks

Top-level Task	Sub-tasks/Deliverables*
Task 1 – A TMC Concept of Operations	1.1 Project Management 1.2 Meetings with Stakeholders 1.3 Initial Policy MOU Development* 1.4 Concept of Operations*
Task 2 – TMC System Integration Design	2.1 System Inventory* 2.2 Functional Requirements* 2.3 System Architecture* 2.4 TMC Design* 2.5 Hardware and Software Specification* 2.6 Fiber Optic/Communications Design* 2.7 Fiber Link MOU Development and Permits*
Task 3 – System Implementation	3.1 Software Design Report* 3.2 Software Development/In-house Integration 3.3 System Documentation*
Task 4 – Testing	4.1 On-Site System Integration/System Testing
Task 5 – Operating Plan, Procedures and Maintenance	5.1 Operations and Maintenance Plan* 5.2 Operating Procedure MOU Development* 5.3 Training 5.4 Software Maintenance

Documents associated with the deliverables are shown in Exhibit 18 – List of Documents Produced and Date(s) of Release.

The MVEM project was originally conceived and included as part of the San Diego Regional Intelligent Transportation Strategic Plan of 1996 and was included as an appendix to the overall Regional Transportation Plan. Project kick-off took place in April 1999. The project has been 7 years in planning and development as of the writing of this document.

The prime contract for the development of the MVEM system was issued to PB Farradyne, in association with National Engineering Technology (NET) Corporation, and Katz-Okitsu, Inc. Each contractor was assigned the following general project responsibilities:

PB Farradyne – Project Management
NET – TMC and Showcase Interface(s)
Katz-Okitsu – Communications Design
Venu Sarakki & Associates – MOU Development
Jacqueline Golob & Associates – Institutional Issues Management

Exhibit 18 –List of Deliverable Documents Produced

Task	Document	Delivery Date
1.3	Draft MOU	2/23/00
1.3	Final MOU	5/5/00
1.4	Draft Concept of Operations	2/23/99
1.4	Final Concept of Operations	3/27/99
2.1	Draft System Inventory	11/23/99
2.1	Final System Inventory	12/16/99
2.2	Draft Functional Requirements	12/3/99
2.2	Final Functional Requirements	1/5/00
2.3	Draft System Architecture	3/17/00
2.3	Final System Architecture	4/11/00
2.4	Draft TMC Specification	8/25/99
2.4	Final TMC Specification	9/27/99
2.5	Draft Hardware/Software Specification	4/21/00
2.5	Final Hardware/Software Specification	5/23/00
2.6	60 % Draft PSE	10/4/99
2.6	100% Draft PSE	11/30/00
2.6	100% Final PSE	2/10/00
2.6	Permits (Coordinated with Caltrans)	2/10/00
2.7	Draft MOU	1/19/00
2.7	Final MOU	3/31/00
3.1	Draft Software Design Report	2/21/00
3.1	Final Software Design Report	3/23/00
3.2	Completion of In-house Integration/Testing	11/15/00
3.3	Draft System Documentation	12/5/00
3.3	Final System Documentation	1/4/01
4.1	Completion of On-Site Integration /Testing	1/15/01
5.1	Draft O & M Plan[3]	NA
5.1	Final O & M Plan[3]	NA
5.2	Draft MOU	7/13/00
5.2	Final MOU	9/25/00
5.3	Training	7/28/03
5.4	Software Maintenance	7/28/03

[3] Draft and Final O&M Plans for this system will be included in future phases of the project under separate funding.

MVEM Pilot Testing

A formal pilot test of the MVEM system was not scheduled as part of the original tasking for the project. However, the project partners completed the system and installed temporary components where necessary, in time to provide MVEM system support for the Super Bowl on January 25, 2003. This event provided an opportunity to informally pilot test the operation of the system to the extent that it had been developed at that time. The functionality of the system during this event was essentially the same as that specified for the final solution with the exception of the HAR capability and communications with McCain CMSs. According to project representatives, another limiting factor included the temporary installation of fiber-optic communications lines that created a link between the TMC and the TOC. The workstation installation at the TMC was also a temporary component, installed just for the purposes of the Super Bowl event. The components were tested informally during the week prior the Super Bowl, with some minor adaptations for local communications at Qualcomm stadium.

San Diego City Police Department, Event Management Office, participated in this event by supplying officers to be trained prior to the event. On the day of the event, one officer was assigned to the workstation at Qualcomm Stadium, two officers and a City traffic engineer were assigned to the workstations at the TOC.

MVEM Acceptance Testing

The final acceptance test for the MVEM IWS was conducted on July 29, 2003 at the San Diego City Transportation Operations Center (TOC). The test was not conducted at Qualcomm Stadium due to damaged fiber optic cable, and there was no test of the workstation at the regional TMC due to a video card failure on the TMC IWS workstation. The City of San Diego project manager considered the acceptance test to be successful. Minor anomalies associated with systems and devices outside the control of the project application software were encountered, and were insignificant relative to the overall success of the acceptance test. Enhancements planned for future phases are expected to accommodate device operational characteristics and/or correct any interface problems. The MVEM server, IWS, and Mission Valley software application performed as expected.

Project partners expect to have other acceptance tests in the future associated with three additional planned builds of the MVEM system and software.

3.2 System reliability, availability, compatibility, and scalability

This section focuses primarily on the system performance of the MVEM system and software application, and addresses reliability, availability, compatibility, and scalability.

3.2.1 System Reliability and Availability

The MVEM system experienced no major system failures during the evaluation period, but not all aspects of the system were available for operation during the period of the evaluation.

A fiber optic cable link between the San Diego City TOC and Qualcomm Stadium's EMC was damaged by construction activities during the period of the evaluation. Additionally, the City performed a fiber optic cable upgrade during this period, which further delayed the reestablishment of communications between the workstation at the stadium and the workstations at TOC and TMC. The workstations at all three locations were operational during the evaluation period; however communication was only available between the TOC and the TMC.

System or process failures are logged by the Intertie Server at the TOC and stored in text files. The server sends an email to designated recipients to inform them of these events. CMS usage logs keep a record of messages displayed on the various signs controlled or monitored by the system. CCTV and HAR usage is not logged, nor are failures or availability of field devices logged by the MVEM system as of this phase of development. A complete description of the logging capabilities of the system can be found in Appendix B.

3.2.2 Compatibility

MVEM is compatible with devices and systems specified in the functional requirements.

Compatibility is the ability of two or more systems or components to perform their required functions while sharing the same hardware or software environment.

The MVEM system demonstrated compatibility as specified by the functional requirements with the field devices and systems with which it shares data and information. Users of the MVEM integrated workstation indicated only one major compatibility issue with their legacy system capabilities. This issue is related to the number of lines of text that can be programmed to appear on the CMSs in their control. Operators prefer the old system's ability to allow them to program a three-line message. The current build of the MVEM system does not provide this capability. Project representatives indicate that this capability will be provided in future builds of the system.

3.2.3 Scalability

The MVEM software and system architecture are designed to allow expansion of the system to accommodate the addition of users without limitation.

Scalability describes the extent to which system usage can grow without sacrificing system performance or requiring architectural or technology changes. The extent and ease with which the MVEM system can be scaled depends on two primary factors:

- *Hardware capability* – The MVEM system uses a modified client-server architecture, where any client may also act as a server. This architecture allows unbounded expansion of the system. The constraints to the system lie with the communications architecture and network component capacity. Currently communications are via fiber-optic cable using Gigabit Ethernet switches to connect to local area networks. Even as new centers are added and new workstations are brought on line, the likelihood of exceeding the available bandwidth is low.

- *Software design* – Subsequent builds of the MVEM software will continually address changes in capacity through the original object-oriented approach. This approach provides processing capability within each workstation and thus distributes the workload across all workstations connected along the network.

3.3 Impact of Showcase Integration on Project Deployment and System Performance

3.3.1 Impact of MVEM on other Showcase Projects

MVEM is the first Showcase Project to integrate event traffic management data with the regional distributed network.

The regional integration efforts planned between MVEM and other management systems currently under deployment in the San Diego region are predicated on the development of the Regional IMTMS network and the common network services it provides. San Diego regional Showcase projects originally intended to use network services provided by Kernel Version 1.0, but subsequent updates to the regional system architecture and network management considerations have resulted in the San Diego region's decision to migrate toward a more distributed management structure. Several Modal Intertie servers are providing the same network management functions as the single Kernel server.

MVEM establishes standards and interfaces to allow event traffic management and other field device management systems to share information with other transportation management systems on the IMTMS regional network.

3.3.2 Impact of other Showcase Projects on MVEM

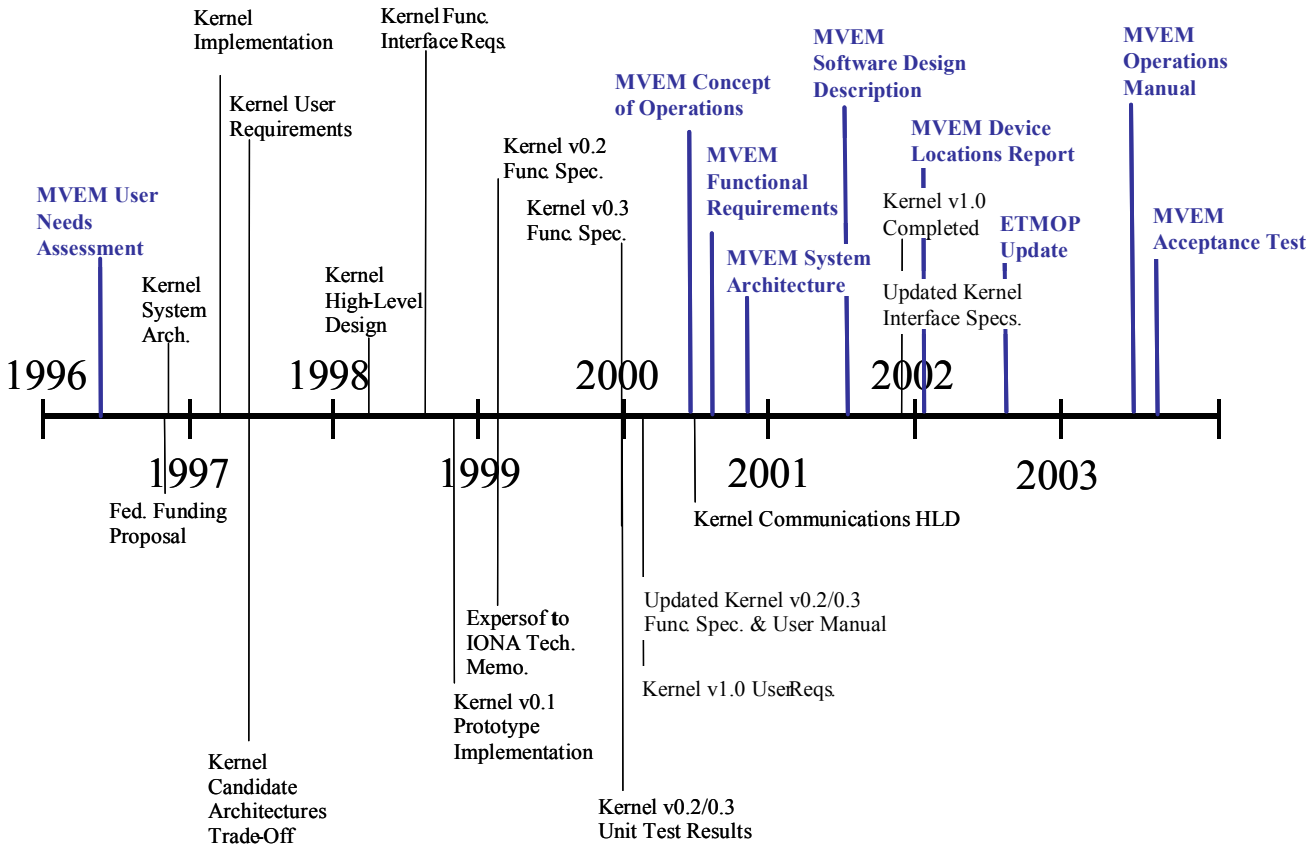
The primary impacts of Showcase on MVEM are associated with design and development of the Kernel interface and the distribution of the IONA site licenses.

The San Diego region has adopted an overall ITS deployment plan that accommodates on-going Showcase-based CORBA deployments, as well as setting the groundwork to take full advantage of the emerging XML and web services based tools. San Diego ITS projects will use a CORBA-based protocol and Showcase-based architecture to serve the planned CORBA clients.

A major goal of the MVEM project was the development and deployment of a computer workstation that could be connected to a wide-area network that would allow cities and agencies within the San Diego region to share transportation system management information. The workstation was architected with the needs of the entire region as a basis for the design and allows the agencies and cities to view other agency's traffic signal devices, changeable message signs, closed circuit television cameras, and depending upon agreements between the agencies, share control of these field devices on a single integrated user screen. The Showcase funding for MVEM accomplished this goal by developing the integrated workstation (IWS), which is the prototype for the regional integrated workstation (RIWS).

In the future, the RIWS is expected to be deployed to other city and other agency transportation and traffic management centers around the San Diego region. This deployment will further expand the capabilities of the IWS and RIWS to participating jurisdictions.

Exhibit 19 – Joint Timeline of the MVEM and Kernel Early Start Project



4 Cost Evaluation

The cost evaluation draws information from documented costs and personal interviews. Budget information was taken directly from the project's contracts and amendments, while operations and maintenance costs were obtained from discussions with agency personnel. Informal interviews were conducted to verify information and fill in any "holes" that were discovered during analysis.

4.1 Constraints & Assumptions

This cost evaluation is based on costs as reported by the project and contract managers. The contract costs indicate the final value of the contract including any amendments.

- The MVEM project was let as an agreement in two parts as two distinct contract types. The first part of the contract was a firm fixed price contract and the second part was a cost-plus management fee (CPM) contract. The two parts of the contract are distinguished primarily by project management activities versus integration and development activities. This distinction however is not entirely consistent throughout each part of the overall contract.

- Operations and maintenance costs will be included under future contracts for upgrade and enhancement of the IWS and RIWS.

4.2 Project Budget & Estimated Development Costs

4.2.1 Project Budget

The MVEM contract was issued by two methods: Fixed Price and Cost Plus Management Fee. The purpose for the two types of contracting methods was not disclosed by the project partners. The contract budget is illustrated in the following table in Exhibit 20.

Exhibit 20 – Total Budgets of the MVEM Contract(s)

Contract	Contractor	Contract End Value	Percentage
Mission Valley ATMS/ATIS (Fixed Price Contract)	PB Farradyne	$161,963.48	35.8%
Mission Valley ATMS/ATIS (Cost Plus Management Fee Contract)	PB Farradyne	$290,448.48	67.2%
		$452,411.97	100%

The initial and final budgets for each of the project tasks are shown in Exhibit 21 and the final budget distribution is illustrated in the chart shown in Exhibit 22. Overall, the tasks that required the largest share of the budget for this project included those related to:

- Software design, development, integration, testing and maintenance,
- Project management,
- Meeting and coordination with project stakeholders,
- Fiber optic cable and communications design.

Exhibit 21 – MVEM Systems Integration Budget per Task

Task	Cost Item	Initial Budget	Initial %	Final Budget	Final %
1.1	Project Management	$36,000.00	9.16%	$53,062.24	11.73%
1.2	Meetings with Stakeholders	$36,000.00	9.16%	$43,833.76	9.69%
1.3	Initial Policy MOU Development	$5,400.00	1.37%	$5,400.00	1.19%
1.4	Concept of Operations	$7,200.00	1.83%	$7,200.00	1.59%
2.1	System Inventory	$7,200.00	1.83%	$7,200.00	1.59%
2.2	Functional Requirements	$7,200.00	1.83%	$7,200.00	1.59%
2.3	System Architecture	$7,200.00	1.83%	$7,200.00	1.59%
2.4	TMC Design	$7,200.00	1.83%	$7,200.00	1.59%
2.5	Hardware and Software Specification	$7,200.00	1.83%	$7,200.00	1.59%
2.6	Fiber Optic/Communications Design	$17,400.00	4.43%	$25,400.00	5.61%
2.7	Fiber Link MOU Development and Permits	$5,400.00	1.37%	$5,400.00	1.19%
3.1	Software Design Report	$14,400.00	3.67%	$14,400.00	3.18%
3.2	Software Development/In-house Integration	$144,000.00	36.66%	$170,194.41	37.62%
3.3	System Documentation	$15,500.00	3.95%	$15,000.00	3.32%
4.1	On-Site System Integration/System Testing	$28,800.00	7.33%	$28,800.00	6.37%
5.1	Operations and Maintenance Plan	$7,200.00	1.83%	$7,200.00	1.59%
5.2	Operating Procedure MOU Development	$5,400.00	1.37%	$5,400.00	1.19%
5.3	Training	$6,840.00	1.74%	$6,840.00	1.51%
5.4	Software Maintenance	$20,000.00	5.09%	$20,138.41	4.45%
Travel	Travel	$6,275.00	1.60%	$6,715.36	1.48%
ODCs	ODCs	$985.00	0.25%	$1,427.79	0.32%
	Totals	**$392,800.00**	**100.00%**	**$452,411.97**	**100.00%**

Exhibit 22 – Final Distribution of MVEM Budget by Task

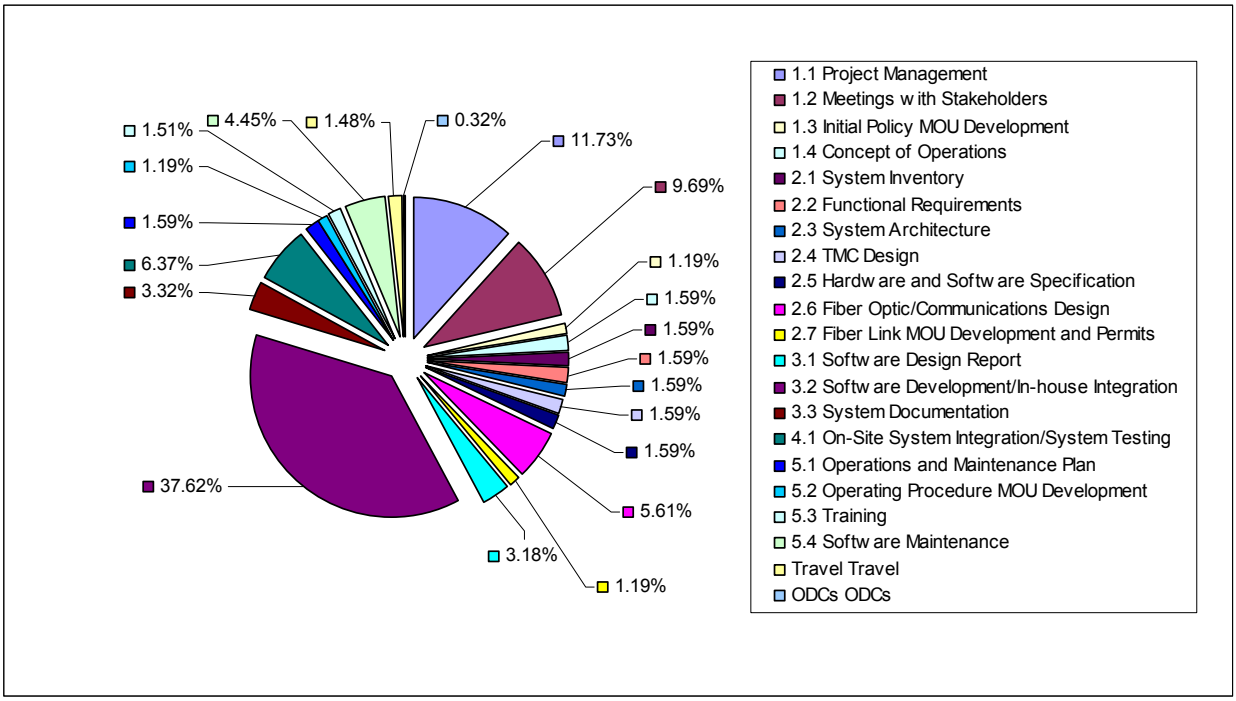


Exhibit 23 is a description of hardware and other fixed costs incurred for the MVEM project. Costs are reflected in year purchased dollars (1999 – 2003).

Exhibit 23 – MVEM Hardware Costs

Hardware Item	Model	Installed OS/Software	Qty	Unit Cost[o]	Total Cost
Integrated Traffic Management Workstation Server	Sun, Ultra 10 Model 440	Solaris 8	1	$6,090	$6,090
Integrated Traffic Management Workstation Computer	Dell, Dimension 8200 Series	Windows 2000 Professional	3	$3,284	$9,852
Video Card	Osprey 100	NA	6	$177	$1,062
LAN Hub	3Com Superstack II, 24-port 10/100	NA	1	$919	$995
Miscellaneous Cables & Ancillary Equipment	Various	NA	Various	Various	$3,249
					$21,248

4.2.2 Design Once, Deploy Many Times

The MVEM project has aptly demonstrated SCPC Showcase concept of design once, deploy many times.

A unique aspect of the MVEM project is its vital role in the development of the regional integrated workstation. This project was the first project in the San Diego area to deploy the workstations that are planned for use throughout the region as part of the regional network. This workstation, as designed in the MVEM project, is currently being deployed in other cities and agencies throughout the region to support additional traffic management activities such as shared traffic signal information and control.

The cooperative design of the workstation and the operation of regional field devices were due largely to continuous coordinated planning at inter-agency meetings, and the development of the Event Traffic Management Operating Procedures (ETMOP). The ETMOP document created a hierarchy of procedures and protocols associated with the sharing of field device information and control between agencies in the region. It is expected that similar procedural documents expanding the number and type of field devices and increasing the number of involved agencies will be developed in the future as additional infrastructure and devices are deployed for regional use.

4.3 Estimated Operations & Maintenance (O&M) Costs

4.3.1 Operations

The operation of the MVEM system is primarily a function of the City of San Diego TOC manager in cooperation with Caltrans and Qualcomm stadium during special events. The system is operated periodically on an as needed basis. Full time daily operation of the system has not been necessary as of the completion of this report. The operations costs for MVEM are based on information received from the project partners and reflect the only what was made available to the evaluation team. The operations cost evaluation for MVEM focuses on three contributing components: labor costs, utility costs, and office space costs.

4.3.1.1 Labor

Labor costs for the support of the MVEM system have been absorbed as part of the responsibilities of existing staff at the locations where the workstations are currently deployed. City of San Diego traffic engineering and police department personnel were trained to operate the RIWS. The San Diego City TOC (where the RIWS and Intertie Server are located) is staffed periodically by traffic engineering personnel, but there are none dedicated exclusively to the facility. Management of the facility, including periodic operation and maintenance, is performed by a San Diego City traffic engineering manager as part of his daily responsibilities.

4.3.1.2 Utilities

The primary assumptions in calculating the following utility costs for MVEM include:

- Average electricity rate per kW-hour for the region/season is $0.16/kW-hr
- Server and/or workstation operating schedules are 8 hours per day, 7 days per week, 48 weeks per year. Monitors are in "sleep" mode 16 hours per day, and approximately 45% of the time during the 8-hour working day.
- Field devices are not included in this schedule due to unavailability of current or historical records that specify annual costs for operations, maintenance, or repairs.
- Telecommunications service is provided by existing city-owned fiber optic lines, which are funded and maintained through the City's overall facilities budget. There are no additional telecommunications costs specific to this project.

Exhibit 24 – Estimated Marginal Annual Electricity Costs for MVEM Equipment

Hardware Item	Model	Power Draw	Power Cost	Est. Annual Cost
1 Integrated Traffic Management Workstation Server	Sun, Ultra 10 Model 440	250W ea.	$0.16/kW-hr	$108
3 Integrated Traffic Management Workstation Computer	Dell, Dimension 8200 Series	250W ea	$0.16/kW-hr	$324
4 Color Monitors (EnergyStar)	Dell or ViewSonic	15W-75W ea	$0.16/kW-hr	$45
				$477

4.3.1.3 Office Space

The space occupied by the servers and workstations is existing office space owned and operated by the City of San Diego, Qualcomm Stadium, or Caltrans/CHP. No equipment was displaced in the installation of any hardware associated with this project and no additional costs could be accounted for at the time of this report.

4.3.2 Maintenance

An operations and maintenance plan and budget is planned to be developed for the MVEM project during future contracts for subsequent builds of the RIWS. The operations and maintenance budget under this contract was reallocated to other system development tasks. Maintenance costs for the MVEM system were not available at the time of this report.

5 Institutional Impacts Evaluation

5.1 Impacts to Operations and Maintenance Policies and Procedures

The MVEM project is unique in that it developed a cooperative agreement, for shared control of the system, between agencies that traditionally had no such agreements.

The operations concept for the MVEM project is depicted in the ETMOP document. The ETMOP focuses on procedures and protocols that provide direction for shared operation of the field devices and systems connected to the regional network. Based on this report, the operation of the system will be a shared responsibility among the partner cities and agencies connected to the regional network. The institutional coordination pioneered by this project has been recognized by project partners and external organizations (such as Intelligent Transportation Systems of America (ITSA), and Women's Transportation Seminar (WTS)) for it strides toward the realization of a regional, integrated, cooperative transportation management and information system. A technical operations and maintenance plan is to be developed for the MVEM project during future contracts for subsequent builds of the RIWS.

The development of the ETMOP was guided by the project manager and developed through a series of working sessions and meetings to reach consensus on the type and hierarchy of procedures, and participating agencies responsible for performing the procedures.

The review and approval of ETMOP was shared by the project partners and final approval was a consensus between the contracting and managing agencies – City of San Diego, California Department of Transportation, and SANDAG.

The complete ETMOP document can be found in Appendix E of this document.

5.2 Impacts to Staffing/Skill Levels and Training

The deployment of MVEM did not require the deletion or addition of any staff to operate or administer the system or its subcomponents.

Training was provided to San Diego Police Department personnel prior to operation of the MVEM system during the Super Bowl. Training was also provided to San Diego City Traffic Engineering Department personnel to familiarize them with MVEM's user interface and system administration.

The administration and management of the MVEM system at the TOC is now the responsibility of the City of San Diego Traffic Engineer who was also responsible for the management of the MVEM project.

5.3 Impacts to the Competitive Environment

The MVEM system developers, system design, or contracts have imposed no proprietary constraints on use or continued development of similar systems.

The system was well documented through the MVEM project and also through associated projects that are also to be integrated with the regional network. Common, object-oriented modules developed for data exchange in this project will be reused in the replication of additional instances of the RIWS in other agencies and for other transportation system management applications. This common standard has potential to provide a more open competitive environment for transportation system developers in the San Diego region.

System documentation and source code was provided to the City of San Diego as part of the MVEM contract requirements.

5.4 Impacts to Local Planning Processes, Policy Development, and the Mainstreaming of ITS

As stated earlier, the MVEM's achievement of a common interagency operations policy (the ETMOP) will provide an example for the development of future similar policies throughout the ITS community.

6 Traveler and Transportation Information Management Evaluation

The MVEM system demonstrated great potential for continued cross-jurisdictional monitoring and control of field devices and sharing of transportation information. The purpose of this chapter is to describe this potential and discuss findings based on available system usage data collected, and anecdotal evidence collected through interviews with project partners. It must be noted, however, that during the period of the evaluation, system usage was light and periodic and the system never reached a level of stable, steady-state operation that would permit a meaningful evaluation of usage and transportation information management.

6.1 Extent of Regional and Interregional Transportation and Traveler Information Integration Between Agencies

The MVEM system has demonstrated the potential for regional transportation information integration between project partners and future agencies that choose to integrate with the IMTMS network through the use of the RIWS.

This project demonstrated the integration of three agency partners (San Diego City, Caltrans, and Qualcomm Stadium) on a common network, sharing a common interface, for the purpose of sharing transportation management information between them. This project went one step further in that it also developed protocols for and implemented shared field device control capability between the project partners. The San Diego region vision includes the integration of nearly all transportation management agencies on the IMTMS regional network sharing transportation information and developing a regional protocol for shared control of field devices. Thus, the vision of the MVEM project, and the San Diego region, is essentially a microcosm of the vision of the Southern California Priority Corridor Showcase Program. Regional integration in San Diego has become a first step toward interregional integration in Southern California. The MVEM project has provided a demonstration of the Showcase intended capabilities within a small sub-regional implementation.

6.2 Utilization of Regional and Interregional Transportation and Traveler Information by Public Agencies

During the period of this evaluation, the utilization of transportation information by the personnel at the TOC, Qualcomm Stadium EMC, and Caltrans was light and periodic.

CMS system usage logs indicated the frequency of use of the system and the types of messages that were displayed. Most of the system usage during the evaluation period was related to system testing, with a minor number of uses related to stadium events, or a special traffic condition. Communication between the TOC and the Qualcomm Stadium EMC were also hindered during the evaluation period by fiber optic cable damage and repairs, which limited the use and testing of the system in the vicinity of the stadium. The TOC manager and Caltrans representatives performed weekly tests of the system where messages were displayed and changed on CMSs and CCTV images were viewed and controlled by each agency. Logs of CMS usage indicated the

type of messages displayed and when tests were conducted. A summary of the CMS usage during the evaluation period in 2003 is provided in Exhibit 25. This data has been provided to indicate the light and periodic level of usage during the evaluation period.

Exhibit 25 – MVEM CMS Usage Summary

Month	Number of Uses	Display Type %
June	15	71% Test Messages; 23% Blank Default; 6% Advisory Messages
July	77	51% Test Messages; 45% Blank Default; 5% Advisory Message
August	16	94% Blank Default; 6% Test Messages
September	6	50% Test Messages; 50% Blank Default
October	0	No usage logged for this month
November	15	50% Test Messages; 50% Blank Default
December	15	55% Test Messages; 45% Blank Default

6.3 Extent to which Comprehensive and Seamless Traveler Information is being Disseminated to – and Used by – the Traveling Public

The MVEM system's dissemination of information to the traveling public is through the display of CMS and the broadcast of HAR messages during events and when otherwise required due to special traffic conditions in the region. Use of the CMS and HAR information by the traveling public was not measured during the evaluation period due to system outages caused by fiber optic cable damage and upgrades in the Qualcomm Stadium vicinity.

As the RIWS is deployed throughout the San Diego region, it is expected that the system will provide more extensive traveler and commuter information beyond that of event-related information.

7 Transportation System Impacts Evaluation

The purpose of this chapter is to describe the likely impacts of the MVEM system on the shared control and display of transportation system management devices in the San Diego region. This phase of the MVEM project was intended to provide the foundation for the multi-agency network of transportation management systems through the development of the IWS, the precursor to the RIWS. During the period of the evaluation, system usage was light and periodic and the system never reached a level of stable, steady-state operation that would permit a meaningful evaluation of transportation system impacts. However, to the extent possible, anecdotal evidence gathered in interviews with stakeholders is presented here to suggest where system impacts may potentially be greatest, with wider deployment of RIWS throughout the San Diego region.

7.1 Impacts to Mode Shifting and Intermodalism

The impact of the MVEM system to mode shift during events at the stadium and in other vicinities where CMSs and HAR are deployed is expected to be greatest during stadium events where messages regarding transportation options to the venue can be displayed or broadcast. The impact of the MVEM system CMSs and HAR to encourage the use of the trolley, bus service, and carpooling, would need to be measured over subsequent events and seasons to accurately determine the changes in transit ridership, traffic flows, and parking at or near the venues affected. It is expected that transportation options information through the MVEM CMS, HAR, and other transit public relations campaigns will likely increase trolley ridership, use of even related bus services, and carpooling to ease event related traffic congestion and parking overflow.

7.2 Impacts to Traffic Congestion

While this phase of the deployment of the MVEM system is complete, region wide deployment of the RIWS is planned in future phases of system development in coordination with other IMTMS network development tasks. As RIWS capabilities are enhanced and made available to other agencies and jurisdictions, event-related traffic congestion reductions and traffic flow improvements are expected to be one of the outcomes of the MVEM system deployment. Until additional system development phases are completed, traffic congestion impacts cannot be assessed.

8 Conclusions and Recommendations

The MVEM project accomplished its initial goal and is poised to continue contributing to the regional vision of connected transportation and traffic management systems through subsequent builds of the RIWS.

The MVEM was an important part of a much larger regional picture of transportation system management. This project is tightly connected to several other projects occurring in parallel in San Diego. Each of these projects adds a component that supports the development and deployment of this regional transportation management system and the regional IMTMS network.

The planning and policy development approach used by MVEM project management capitalized on a business planning, rather than system planning, methodology that achieved a mutually beneficial set of operating procedures for the project partners. This approach was costly in terms of time spent developing consensus between project partners, however, long term benefits of interagency cooperation will far outweigh this initial investment.

During the period of the evaluation use of the MVEM system was light and periodic with the City of San Diego as the primary user of the system. As the system is deployed to other agencies and usage increases, additional assessments of the system may be helpful in understanding how and when operators will find it to be most useful.

The continued success of the MVEM system and its successors will depend largely on the support of regional transportation agency leaders and their willingness to strongly encourage the integration of the new information systems technologies into the daily transportation management procedures at the operator level.

Future builds of the RIWS must work closely with individuals responsible for daily operations to ensure that design of the information system expedites the accomplishment of their tasks, simplifies and improves upon current operating procedures, and integrates well into their workplace culture.

Appendices

Appendix A - MVEM System Configuration Detailed Specifications

MVEM Hardware Configuration

The Mission Valley ATMS/ATIS Phase II Project has implemented a traffic management system for following hardware configuration items. These are:

- Intertie Server (IS)
- Regional Integrated Workstation (RIWS)
- COHU Master Processor Controller (MPC)
- Vicon Video Switch Matrix (VSM)

Intertie Server (IS)

The Intertie Server (IS) computer is located at the City of San Diego Transportation Operations Center (TOC). The Sun Ultra 10 Workstation was selected as the computer platform because of its cost, processing, and compatibility attributes when compared to similarly equipped competitor computer platforms. The Sun Ultra 10 Workstation performs the server process-to-process operations. The Sun Ultra 10 Workstation components are detailed as follows:

SUN Microsystems Ultra 10 Workstation

- Processor Speed: 440Mhz
- Random Access Memory: 512MB
- Hard Disk Capacity: 9GB
- CDROM: 32X
- Graphics Card: Creator 3D Graphics
- Video Card: Sun Video Plus 1.3 Real-time Video/Audio capture and compression
- LAN: 10/100 Base T Ethernet
- Maintenance/Support 2yr Silver Support w/ 7X24 uplift (on-site & phone)
- Video Card Software Sun TV
- Power 100-120 VAC, 47-63 Hz, and 0.3 KVA
- Operating Temperature 10 ºC to 35ºC
- Operating Humidity 40% to 80% relative humidity
- Storage Temperature -20 ºC to 60 ºC
- Height 40.2 cm (15.8 in.)
- Width 17.6 cm (6.9 in.)
- Depth 43.5 cm (17.1 in.)
- Weight 20.0 kg (44 lb.)

Cables/Other

- Monitor Coaxial Cable
- Power Cables (Monitor, Workstation)
- Mouse Cable
- Category 5 Network Cable (6')

Commercial Off the Shelf Software (COTS)
- ILOG Jviews 3.5 Run-time license
- IONA Orbix CORBA 3.3 Run-time license
- Solaris 8 Operating System

Application Software
- Mission Valley 1.XX

Regional Integrated Workstation (RIWS)

The RIWS computer is the operator workstation running the Mission Valley application graphical user interface (GUI). There are currently three RIWS computers in operation, one at each of the following locations:

1. City of San Diego TOC
2. Qualcomm Stadium Observation Room ("Crow's Nest") and Emergency Management Center (eventually to be moved to the Stadium Security Office at Gate A, date of move TBD)
3. Caltrans District 11 TMC Viewing Room

The IWS computer has the following specifications:

Compaq Presario
- Processor Speed: 800Mhz
- Random Access Memory: 256MB
- Hard Disk Capacity: 9GB
- CDROM: 32X
- LAN: 10/100 Base T Ethernet
- Monitor w/video adapter: 17 inch
- Video Card: Osprey

Cables/Other
- Monitor Coaxial Cable
- Power Cables (Monitor, Workstation)
- Mouse Cable
- Category 5 Network Cable (6')

Specifications
- Mounting: desktop unit
- Height: 14"
- Width: 14"

- Depth: 14”
- Supply Voltage: 120VAC

COHU Master Processor Controller (MPC)

Basic description, specifications and information TBD

Vicon Video Switch Matrix (VSM)

Basic description, specifications and information TBD

Field Devices:

CCTV Specifications

(COHU, basic specifications) TBD

CMS Specifications

(American Electronics Systems and McCain, basic specifications) TBD

HAR System Specifications and Equipment

The MVEM HAR system consists of an AM transmitter, coupler, audio processor, solid-state recorder/player, antenna, grounding systems, transient lightning suppression, battery back-up/charging systems, external digital recorder/player microphone and control speaker phone.

Transmitter:	FCC TIS Service from 530 kHz to 1710 kHz
Operating temperature range:	-30 C to 60 C. Operating humidity range shall be from 20% relative at 30 C to 95% relative at 50 C
Signal strength:	2-millivolt/meter at a distance of .93 miles from the station
Transmitter output:	Maximum of 10 wafts
Primary Power Input Provisions:	For the operation from 117+1-10% volts AC 60 Hz single phase, at a power input not to exceed 100 continuous wafts
Power backup:	Automatic switching battery back-up system operating at no performance degradation for 12 hours
Operator Controls:	DTMF control via a user friendly voice prompted menu both locally at the HAR site and remotely via dial-up telephone line
Communication protocol:	NTCIP
Message Storage Capacity:	250 messages; 60 minutes total recording time

Antenna:	Center load vertical whip with a loading coil.
Memory Power and Backup:	117 VAC and 14 VDC or 117 VAC and 12 VDC (power consumption not to exceed 10 amps from either source)

HAR Recording features:

- Monitor oft-air output of transmitter
- Recording messages
- Playback of recorded messages
- Erasing of messages
- Set time span between messages
- Set play list sequence
- Hear play list sequence
- Set recording source input
- Set recording speed
- Set background source material message
- Set clock time and day of the week
- Set message schedules
- Hear message schedules
- Cancel message schedules
- Set play list number
- Hear play list number
- Cancel play list number
- Stop record
- Set remote record security code
- 911 emergency messaging schedule feature

The HAR recording and editing functions are accessible remotely and locally. The recorder can configure the message repeater mode using DTMF tones.

Interagency Communications Infrastructure:

- Fiber Optic Cable between devices and regional integrated workstation servers TBD
- Internet/virtual private network between server locations TBD

Appendix B – System Log Files

System or Process Failure Notifications

When a process fails on the Intertie Server (IS), the system automatically generates an email message to the workstation. The system administrator is then able to open the email and review what process or processes have failed. The process will automatically restart after a specific time period. The system administrator will then receive another email indicating that the process has restarted.

On the Intertie Server system, error log files kept on all failed MVEM system processes to help the System Administrator maintain the system. Error logs can be reviewed on the Intertie Server via the following UNIX commands.

% cd /var/adm/

% cat messages

The above commands move the System Administrator to the correct directory and then display the log file. This file lists the recent events that have occurred on the system, i.e. if a process has failed and is then automatically restarted.

CMS Usage Logs

The Intertie Server system also logs usage of the CMS and any messages that were displayed. Note: CCTV or HAR usage is not currently logged. The CMS log files are stored by month and then by sign number.

% cd opt/netcorp/var/cmslog/2003/month/

% cat sign#.txt

Therefore, in the above example, *month* is the month to be reviewed and *sign#* is the actual CMS sign number.

For each sign, there is a unique file, i.e. for CMS sign 7, there is a file titled 7.txt. This lists the information concerning that sign and any messages displayed on that sign. It will also list the user who initiated the display command, which agency the user is associated with, and the time of the message. System log files are displayed on the server in the following format:

CMS MSG LOG ENTRY:
User=mviws
Agency=San Diego
Send Time=Thu Jun 26 10:37:54 2003
Display Msg Type=Displaying Message
Phase 1:
Text Line 1=TEST
Text Line 2=

CMS MSG LOG ENTRY:
User=Software default message
Agency=San Diego
Send Time=Thu Jun 26 10:40:58 2003
Display Msg Type=Displaying Blank Default
Phase 1:
Text Line 1=

CMS MSG LOG ENTRY:
User=mviws
Agency=San Diego
Send Time=Thu Jun 26 13:30:14 2003
Display Msg Type=Displaying Message
Phase 1:
Text Line 1=PHOTO
Text Line 2=ENFORCEMENT
Phase 2:
Text Line 1=ACTIVATED
Text Line 2=AT 10TH & A

Appendix C - MVEM Interview Guide

Measure 1.1.1 (The System Development Process)

PB Farradyne/NET/City of San Diego

1. When did the project kick-off?

2. Was a Concept of Operations (ConOps) developed during the project? If so, at what point, and who was involved in its development?

3. What other deliverables were developed and on what date was each one finalized?

Measure 1.2.1 (NA)

Measure 1.2.2 (NA)

Measure 1.2.3 (Compatibility)

City of San Diego/SDPD/Stadium/Caltrans (system operator)

1. Have there been any indications of interference or incompatibility between your legacy system(s) and the MVEM system?

Measure 1.2.4 (Scalability)

PB Farradyne (system developer)

1. Please describe the system's architecture – both software and network design.

2. How many additional affiliates can the system support?

Measure 1.3.1 (Impact of Showcase Integration on Individual Projects)

PB Farradyne/City of San Diego/Caltrans

1. What was the MVEM's originally contracted period-of-performance (POP)?

2. To what extent did integration with the Kernel or other Showcase projects impact the MVEM's design and/or schedule?

3. Did your agency procure any hardware or software for the Showcase Program on behalf of the Priority Corridor? If so, please list the items and their estimated costs. Also indicate if these are one-time costs or ongoing (monthly) costs.

4. Were there any other unplanned hardware/software/enabling technology purchases or upgrades that resulted from Showcase? (For example, required yet unexpected upgrades to databases, radios or other systems). Please list them.

5. Were there any other unusual technical issues or concerns created by Showcase that impacted your project? If so, what actions did you take to deal with them?

6. Were there any institutional issues, preferences or concerns created by Showcase that impacted your project?

7. What were the most important lessons learned from the MVEM project?

Measure 2.1.1 ("Design Once, Deploy Many Times")
PB Farradyne/City of San Diego
1. Do you feel that "Design once; deploy many times" has been achieved? Why or why not?

Measure 2.2.1 (O&M costs (labor, utilities, space, etc.))
City of San Diego/SDPD/Stadium/Caltrans
1. Who sets the agency's O&M budget, and what is the procedure for requesting a budget change (i.e., for getting a new system included into the annual O&M budget)?

2. Please estimate or provide the documented monthly totals associated with each of the following:
   a) labor hours for technicians to operate/maintain the MVEM system.
   b) electric utility costs associated with operating MVEM.
   c) telecommunications costs associated with operating MVEM.
   d) cost of office space that MVEM equipment occupies.
   e) labor hours spent on maintenance of the MVEM system.
   f) cost of replacement hardware/software associated with maintenance activity.
   g) ongoing costs for software licenses.

Measure 3.1.1 (Changes in O&M procedures/policies)
City of San Diego/Stadium/Caltrans/SDPD
1. Did your agency change any of its policies or procedures as a result of the MVEM?

2. Operations
a) Have you discontinued any tasks or activities that you used to perform because of the MVEM?

b) Has the MVEM impacted how you deal, communicate or coordinate with other agencies (such as local traffic departments, transit providers, law enforcement, media, ISPs, etc.)?

c) Has the MVEM impacted how other agencies (such as local traffic departments, transit providers, law enforcement, media, ISPs, etc.) deal, communicate or coordinate with you?

3. Maintenance
a) For how much of the MVEM system are your maintenance staff responsible (workstation hardware/telecommunications connection/software)?

b) Did your maintenance staff require any special hardware or software training for MVEM?

c) Did the MVEM system replace any legacy systems that you no longer need to maintain?

Measure 3.2.1 (Staff changes)
City of San Diego/Stadium/Caltrans/SDPD
1. Were any staff hired (either directly or under contract), fired, or reassigned as a result of the MVEM? If so, how many?

Measure 3.2.2 (Number of hours of staff training)
See Measure 4.2.1

Measure 3.2.3 (Job classifications created/deleted)
City of San Diego/Stadium/Caltrans/SDPD

1. Has MVEM impacted the job titles, responsibilities and/or pay of any of your operations staff members?

Measure 3.2.4 (Change in employee turnover rate)
City of San Diego/Stadium/Caltrans/SDPD
1. Has the MVEM system affected your employee turnover rate?

Measure 3.3.1 (NA)

Measure 3.3.2 (Number of ITS standards implemented)
PB Farradyne (system developer)
1. Were any ITS standards implemented in the MVEM system?

Measure 3.4.1 (Number of agencies involved in transportation & traveler information management)
PB Farradyne/City of San Diego
1. How many agencies generate, manage, and/or exchange data using the MVEM system?

Measure 3.5.1 (Impact of Showcase on local planning)
City of San Diego/SANDAG/Caltrans
1. Was an MVEM-like system (it may not have been called by this name at the time) originally called for in the Regional Transportation Plan? If not, has it been added to the plan? Explain.
2. Has either support or expansion of MVEM been included into state or local improvement plans?
3. As far as you are aware, have any other public plans been modified as a result of either the MVEM or Showcase? Explain.
4. As far as you are aware, has the execution of any other plans been temporarily or permanently postponed as a result of either the MVEM or Showcase? Explain.
5. Has an effort been made to inform other planners and policy makers - who may not know about MVEM or Showcase - about the projects? Explain.
6. Did you forego any other transportation improvements in order to fund your agency's involvement in either the MVEM or Showcase? Explain.
7. Was equipment was installed at your agency as a result of the MVEM/Showcase? If so, is there anyone at your agency who is responsible for maintaining an inventory or architecture of that installation?
8. Were any policies (such as procurement policies, business plans, operations policies, etc.) within your organization enacted, revised or dropped as a result of either the MVEM or Showcase?

Measure 3.5.2 (Impact of both public and private sector policy decisions on Showcase projects)
City of San Diego/SANDAG/Caltrans
1. Who sets the policy with regard to MVEM and/or other transportation management and information systems?
2. Are there, or have there been, any policy decisions that affect the use, marketing, operation, maintenance, or expandability of MVEM?

Measure 4.1.1 (Change in number of information exchanges (quantity))

City of San Diego/Caltrans/Stadium/SDPD

1. Have there been any new information or data exchange capabilities enabled through the implementation of the MVEM system? Has there been a change in the volume of information or data exchanged through existing capabilities between participating agencies or the public?

Measure 4.1.2 (Change in communications quality (timeliness and quality of data exchanged))

City of San Diego/Caltrans/Stadium/SDPD

1. For those ISPs that share their own data with the public sector, would you say that their data is of better quality, about the same, or of lesser quality than what the public sector collects? Please explain.

Measure 4.1.3 (Number of new ITS system architecture data flows implemented)

Measure 4.2.1 (Change in agency performance as a result of Showcase)

City of San Diego/Caltrans/Stadium/SDPD

1. How much money do you estimate you save through the use of the MVEM system? Are there other efficiencies or performance enhancements that you have gained through the use of the MVEM system? Please explain.

2. Can you share any examples of favorable or unfavorable feedback from patrons or system operators regarding the systems and devices implemented through MVEM?

Measure 4.3.1 (NA)

Measure 4.3.2 (NA)

Measure 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 5.3.3, 5.4.1, 5.5.1

City of San Diego/Caltrans/Stadium/SDPD

1. Given the current status of the system and your knowledge of its upcoming expansion, what are your expectations for MVEM and its future transportation system impacts with respect to the following topic areas:

5.1.1 Ridership of public transit in target areas
5.1.2 Traveler tendency to consider mode shift during stadium or downtown area events
5.2.1 Frequency and severity of accidents in target areas during target time periods
5.2.2 Perceived safety benefits by travelers
5.3.1 Reduction in delay in target areas during target time periods
5.3.2 Improvement in traffic flows, (potential increase in average speed) during events and at target time periods
5.3.3 Decrease in stop and go traffic
5.4.1 Expectations for improvements in automobile generated pollution
5.5.1 Changes in ridership and length of trip attributable to MVEM
5.5.2 Changes in operational efficiency in targeted areas
5.5.3 Changes in selected operations costs
5.5.4 Changes in number or type of staff required

Measure 5.5.4 (Number of staffing changes required)

See Measures 3.2.1, 3.2.3, 3.2.4

Measure 5.6.1 (NA)

Appendix D – Hardware and Software Detailed Cost Sheet

Mission Valley ATMS/ATIS Equipment List Rev.3
(1/3/02)

Item No.	Item Description	Mfg.	Model	Web Site / e-mail	QTY	Unit Price	Extended Price	Tax (8.25%)	Total Price
	City of San Diego TMC:								
1	Integrated Traffic Management Workstation Server Computer	Sun	Ultra 10, Model 440, 1x440-MHz UltraSPARC-IIi, 2-MB L2 cache, 512-MB DRAM, Onboard PGX24 Graphics,20-GB 7200rpm EIDE Internal disk, 48x CD-ROM, 1.44-MB Floppy, No Country Kit, Solaris 7, 11/99 and Solaris 8, 01/00 Installed	http://store.sun.com/webconfig/BuildConfig.jhtml	1	$ 5,626	$5,626	$464	$6,090
2	Integrated Traffic Management Workstation Computer	Dell	Dimension® 8200 Series, Pentium® 4 Processor at 2.0 GHz Palm m105 (free offer) 1GB PC800 RDRAM New Dell® Enhanced QuietKey Keyboard MS IntelliMouse 3Yr Ltd. Warranty- 3Yrs On-Site Service + Lifetime Phone Support Dell Recommended Microsoft® Windows® 2000 Professional Microsoft® Office XP Small Business[12] Norton Antivirus® 2002, 12-month subscription upgrade 40GB Ultra ATA/100 Hard Drive Dell Recommended 3.5 in Floppy Drive 48X Max Variable CD-ROM 21 in (19.8 in viewable,.24AG) P1130 FD Trinitron® Monitor 64MB NVIDIA GeForce2 MX Graphics Card with TV-OutIntegrated Audio with Soundblaster Pro/16 Compatibility No Speaker Option 56K PCI Data Fax Modem for Windows 10/100 PCI Fast Ethernet NIC	http://ecomm.us.dell.com/dellstore	1	$ 3,034	$3,034	$250	$3,284
3	Video Insert Card	Osprey	100	http://store.viewcast.com/dr/v2/ec_MAIN.ShopMaster	2	$164	$327	$27	$354
4	Commercial off-the-shelf Software - Video Card Development Kit	Osprey	SDK	http://www.viewcast.com/products/osprey/opi.html	1	$2,000	$2,000	$165	$2,165
5	LAN Hub	3COM	Superstack II Hub 500 24-port 10/100		1	$919	$919	$76	$995
6	Commercial off-the-shelf Software - CORBA Server Development License	Iona	Orbix (c++) 3.3 Development Kit		1	$0	$0	$0	$0
7	Commercial off-the-shelf Software - CORBA Server Development Support	Iona	Orbix (c++) 3.3 Development Standard Support		1	$0	$0	$0	$0

Item No.	Item Description	Mfg.	Model	Web Site / e-mail	QTY	Unit Price	Extended Price	Tax (8.25%)	Total Price
8	Commercial off-the-shelf Software CORBA Server Run Time License	Iona	Orbix (c++) 3.3 Run-time License		1	$0	$0	$0	$0
9	Commercial off-the-shelf Software CORBA Server Run Time Support	Iona	Orbix (c++) 3.3 Run-time Standard Support		1	$0	$0	$0	$0
10	Commercial off-the-shelf Software for Real-time Map Java Libraries License (3 pack)	Ilog	Jviews 5.0 Run-time License	czane@ilog.com	1	$0	$0	$0	$0
11	Miscellaneous Cables and Ancillary Equipment				1	$1,000	$1,000	$83	$1,083
	Qualcomm Stadium EMC:								
12	Integrated Traffic Management Workstation Computer	Dell	Dimension® 8200 Series, Pentium® 4 Processor at 2.0 GHz Palm m105 (free offer) 1GB PC800 RDRAM New Dell® Enhanced QuietKey Keyboard MS IntelliMouse 3Yr Ltd. Warranty- 3Yrs On-Site Service + Lifetime Phone Support Dell Recommended Microsoft® Windows® 2000 Professional Microsoft® Office XP Small Business[1][2] Norton Antivirus® 2002, 12-month subscription upgrade 40GB Ultra ATA/100 Hard Drive Dell Recommended 3.5 in Floppy Drive 48X Max Variable CD-ROM 21 in (19.8 in viewable,.24AG) P1130 FD Trinitron® Monitor 64MB NVIDIA GeForce2 MX Graphics Card with TV-OutIntegrated Audio with Soundblaster Pro/16 Compatibility No Speaker Option 56K PCI Data Fax Modem for Windows 10/100 PCI Fast Ethernet NIC	http://ecomm.us.dell.com/dellstore	1	$ 3,034	$3,034	$250	$3,284
13	Video Insert Card	Osprey	100	http://store.viewcast.com/dr/v2/ec_MAIN.ShopMaster	2	$164	$327	$27	$354
14	Commercial off-the-shelf Software for Real-time Map Java Libraries License	Ilog	Jviews 5.0 Run-time License	czane@ilog.com	1	$0	$0	$0	$0
15	Miscellaneous Cables and Ancillary Equipment				1	$1,000	$1,000	$83	$1,083
	Caltrans District 11 TMC (intertim):								

Item No.	Item Description	Mfg.	Model	Web Site / e-mail	QTY	Unit Price	Extended Price	Tax (8.25%)	Total Price
16	Integrated Traffic Management Workstation Computer	Dell	Dimension® 8200 Series, Pentium® 4 Processor at 2.0 GHz Palm m105 (free offer) 1GB PC800 RDRAM New Dell® Enhanced QuietKey Keyboard MS IntelliMouse 3Yr Ltd. Warranty- 3Yrs On-Site Service + Lifetime Phone Support Dell Recommended Microsoft® Windows® 2000 Professional Microsoft® Office XP Small Business[12] Norton Antivirus® 2002, 12-month subscription upgrade 40GB Ultra ATA/100 Hard Drive Dell Recommended 3.5 in Floppy Drive 48X Max Variable CD-ROM 21 in (19.8 in viewable,.24AG) P1130 FD Trinitron® Monitor 64MB NVIDIA GeForce2 MX Graphics Card with TV-OutIntegrated Audio with Soundblaster Pro/16 Compatibility No Speaker Option 56K PCI Data Fax Modem for Windows 10/100 PCI Fast Ethernet NIC	http://ecomm.us.dell.com/dellstore	1	$ 3,034	$3,034	$250	$3,284
17	Video Insert Card	Ospr ey	100	http://store.viewcast.com/dr/v2/ec_MAIN.ShopMaster	2	$164	$327	$27	$354
18	Commercial off-the-shelf Software for Real-time Map Java Libraries License	Ilog	Jviews 5.0 Run-time License	czane@ilog.com	1	$0	$0	$0	$0
19	Miscellaneous Cables and Ancillary Equipment				1	$1,000	$1,000	$83	$1,083
	TOTAL								**$22,330**

Appendix E – Mission Valley Event Traffic Management and Operations Procedure (ETMOP)

Endnotes/References

[1] ISTEA requires that "operational tests utilizing federal funds have a written evaluation of the Intelligent Vehicle Highway Systems technologies investigated and the results of the investigation." Although Showcase is not officially an operational test, it deploys and demonstrates ITS services, functions, and technologies under "real world" conditions, similar to an operational test.

[2] California Statistical Abstract, Table B-4. California Department of Finance, Sacramento, CA. December 2003.

[3] California Statistical Abstract, Table J-4. California Department of Finance, Sacramento, CA. December 2003.